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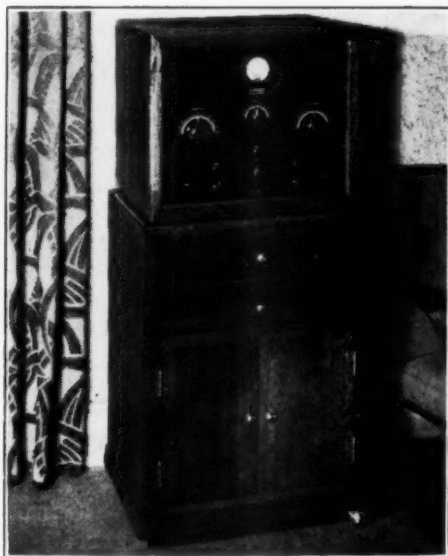
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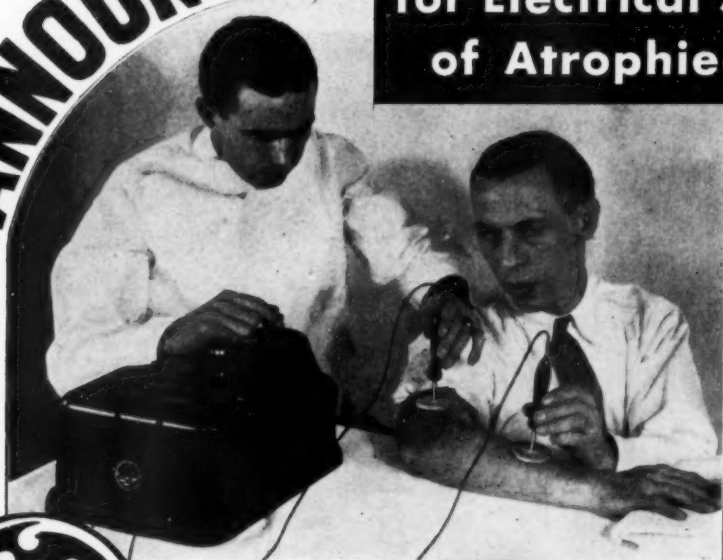
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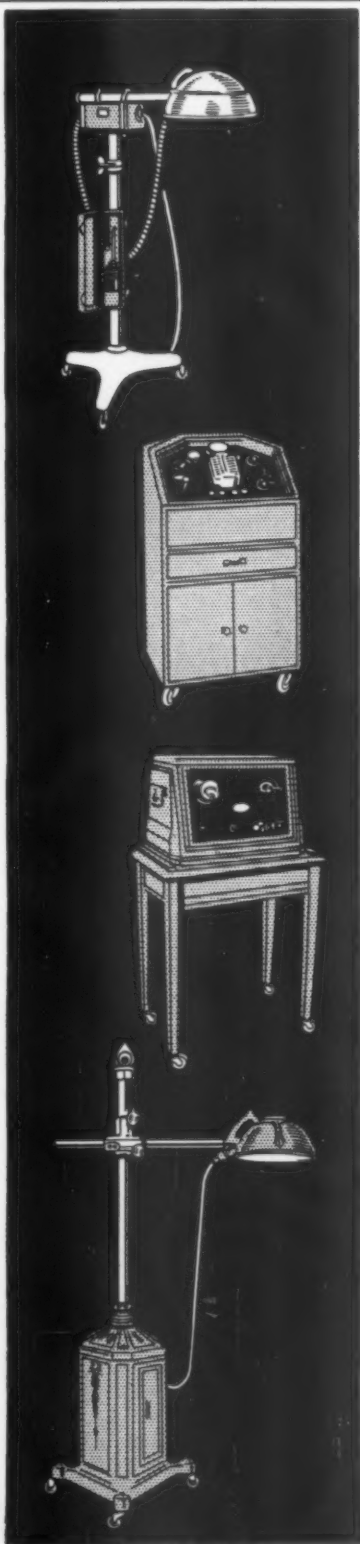


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CANCER OF THE NASAL ACCESSORY SINUSES *

Problems in Diagnosis and Management

FRANCIS L. LEDERER, M.D.

CHICAGO, ILL.

Exhaustive analyses of the statistical material and of the results obtained in malignant neoplasms of the nasal accessory sinuses as published in the recent literature are worthy of note. Green⁽¹⁾, New⁽²⁾, Holmgren⁽³⁾, Hautant, Monod and their associates^(4, 5), Barnes⁽⁶⁾, Denker⁽⁷⁾, Quick⁽⁸⁾, and Öhngren⁽⁹⁾ have written extensively on this subject.

A study of their articles strikingly reveals that only a few have exercised sufficient care in describing the exact location of a sinus neoplasm. In most instances the description of locations is so vague as to convey the impression that many prefer to discuss tumors of the sinuses in general rather than specify neoplastic involvement of a single sinus such as the antrum, for example, as was done by Green⁽¹⁾, New⁽²⁾, and Houser⁽¹⁰⁾.

It is claimed by some authors that "primary" cancer of the antrum has been observed, this, in spite of the fact that all or nearly all landmarks have undoubtedly been obliterated. I am convinced from my own observations, that "primary" cancer of the antrum is of extremely rare incidence, for reasons which I shall bring out in this discussion. Unless this premise is fundamental, there will be a misunderstanding of the problem, more specifically, an incorrect basis for evaluating end-results.

It is my belief that a malignant neoplasm of a nasal sinus is seldom, if ever, confined within a mathematically calculated area. By virtue of the characteristically slow growth of a neoplasm within a bony cavity, it is observed for such a time as to fall within the classification of inoperability when the diagnosis finally becomes self-evident. Before the onset of symptoms such as pain, a sense of fullness, nasal blockage, offensive odor or bleeding, and external signs, such as swelling, could one suspect that a malignant growth is attached to the bony walls of the antrum.

Unfortunately, inspection, auscultation and palpation, anterior and posterior rhinoscopy, endoscopy, transillumination, roentgen examination, and biopsy do not always facilitate a conclusive diagnosis in early cases. Furthermore, confusing clinical pictures are produced by intercurrent or coexisting diseases, particularly by those which cause swellings about the maxilla and orbit. Syphilis and tuberculosis may obscure the diagnosis of cancer thereby delaying proper therapy. Peculiar histological responses of the various tissues to tumor growth and infection may also hinder a correct diagnosis. We⁽¹¹⁾ reported such a case in which a rapidly growing anaplastic type of carcinoma of the nose and sinuses gave rise to retropharyngeal and cervical metastases. Secondary infection produced a virulent septicemia which led to a plasmocellular infiltration and proliferation.

The main objective of this paper resolves itself into a discussion of the diagnostic and therapeutic problems which have not been sufficiently emphasized in recent published reports on cancer of the sinuses. My interest in this work has been prompted by my observations which are in conflict with those of a number of other clinicians. I have already pointed out these facts in a critical analysis⁽¹²⁾ of the problem of cancer of the head and neck.

Davis⁽¹³⁾ has given the results of twelve years observation based on 50 cases of carcinoma of the maxilla and ethmoid. He recognizes two groups of cases, namely, those which arise in the alveolus or hard palate in the region of the molar teeth, and those which seem to originate (it is impossible to say exactly where) from the upper part of the nose or from the sinuses. The growths which arise from the alveolus extend into the cheek sulcus, hard palate and then involve the antrum. These are less malignant and easier to control than tumors in the second group. Davis' results, even in the first group, indicate, in contrast to other statistics, that he was mainly concerned with disease of an inoperable character.

* From the Department of Laryngology, Rhinology and Otology, University of Illinois College of Medicine; Francis L. Lederer, Head of the Department.

* Read at the Spring Session of the Mid-Western Section of the American Congress of Physical Therapy, Madison, Wisconsin, March 12, 1935.

Symptomatology

The symptomatology of malignant growths of the sinuses has been of little aid in estimating the extent of involvement. Contrary to the generally accepted view, very few of my cases had ever experienced sinus disease prior to the insidious onset of nasal blockage, epistaxis and headache. It is interesting to note that the majority of these patients had first been subjected to some sort of surgery for the relief of the nasal obstruction.

Of course, after the tumor has developed and the normal contour of the nasal cavity has been destroyed, the marked facial deformity leaves very little to the imagination in arriving at a correct diagnosis (Fig. 1). Large



Fig. 1. — Carcinoma of the sinuses invading the orbit with marked external deformity.

masses of polyps which protrude from the nares and even cause external deformity are frequently revealed by biopsy to be benign superficially, but continued studies of the pedicle disclose the underlying factor of malignancy. It has been my frequent experience to find that biopsies do not always render possible a conclusive diagnosis; certainly, they should be repeated if there is the slightest suspicion of a malignant neoplasm.

The extent of sinus tumors should be determined by careful roentgenological study, as encroachment on the bones of the skull may be greater than the clinical examination reveals (Fig. 2, a, b, c). The presence of a ma-

lignant growth on the opposite side must also be carefully considered (Fig. 3). The development of ethmoidal and orbital cancer is slow, metastasizing infrequently. There is a definite tendency of such tumors to invade the meninges and other intracranial structures. While the symptoms usually vary, in the main the points to be noted are:

1. Unilateral nasal obstruction,
2. Mucopurulent or serosanguinous discharge,
3. Headaches (usually frontal),
4. Hemorrhage,
5. Fetor,
6. Cranial nerve involvement,
 - (a) Sensory disturbances (neuralgic-like pains, paresthesia and anesthesia),
 - (b) Ocular disturbances (proptosis, limitation of motion, papillitis and atrophy),
 - (c) Olfactory disturbances (anosmia and parosmia),
7. External deformity.

Pathologic Considerations

The present trend to evaluate the treatment of cancer on the basis of the histological picture has been applied in tumors of the sinuses. The types of malignant neoplasms occurring in the region of the sinuses may be classified as:

- I. Epithelial types,
 - Hornified squamous cell,
 - Non-hornified squamous cell,
 - Transitional cell,
 - Lymphoepithelioma and
 - Basal cell.
- II. Connective tissue types,
 - Sarcoma (spindle cell, round cell,
 - Polymorphous, melanosisarcoma,
 - osteoblastic,
 - Fibrosarcoma and myxosarcoma).
- III. Mixed type (glandular form),
- IV. Craniopharyngioma with malignant changes,
- V. Giant cell tumor associated with parathyroid adenoma.

I have described in detail⁽¹²⁾ the possible mode of attack on various types of tumors based upon such factors as the *cellular activity* of the neoplasm, the *anatomical location*, and the *index of malignancy* or the response of the body to tumor invasion. The locale of the sinuses with its intricate network of bony cells, hidden deep recesses, and close proximity to vital structures, presents a

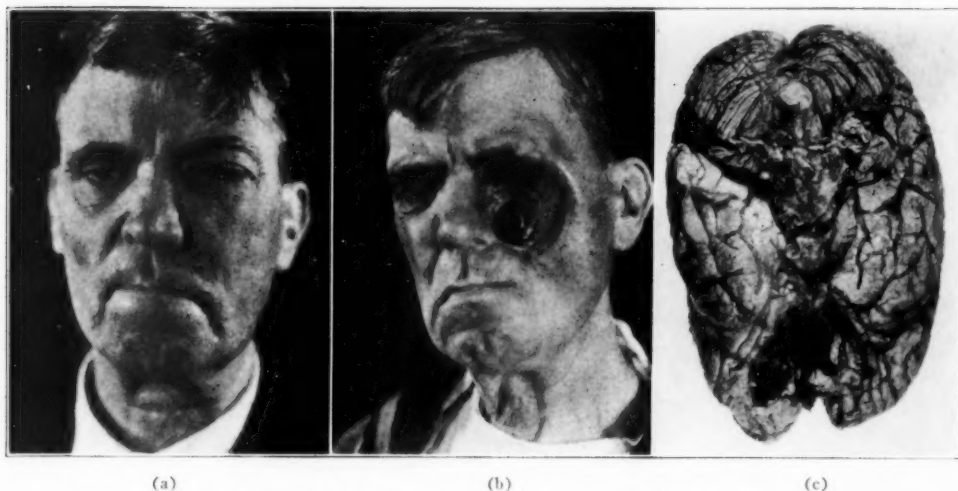


Fig. 2. a — Malignant invasion of the maxillary sinus, the ethmoids and the orbit by a hornifying squamous cell carcinoma. Thorough radiological study indicated that a complete resection would give the patient a chance for cure; b — Following the resection the patient made an excellent recovery. A suspicious area high up on the septum near the cribriform plate (as shown by the darkened area) revealed activity. The patient did well for a time but then gradually lost ground and succumbed. Necropsy revealed an old brain abscess; c — Brain abscess as the result of malignant invasion of the frontal lobe. The tumor tissue eroded the cribriform area and surrounds. The old, well walled-off abscess was found on postmortem.

problem somewhat different than any other area. The interference with physiologic functions is a late manifestation which is of no advantage in early diagnosis. Not alone that, but a neoplastic process in the posterior group of sinuses may tend to grow in such a direc-

tion so as not to make its appearance within the interior of the nose. In this connection hyperplastic-like tissue should be suspected of being malignant, particularly if it has an increased tendency to bleeding. On numerous occasions microscopic examination of such tissue has revealed positive evidence of malignant disease (Figs. 4, a and b).

The origin of sinus tumors is not easily determined. I have already referred to the indiscriminate application of the term "primary" with reference to malignant growths of the antrum. With rare exceptions, the pathologic process is such as to render it difficult to determine whether the growth springs from the alveolar process, the lateral wall of the nose, the ethmoids or some other structure. Öhngren⁽⁹⁾ has stated that growths lying anterior and inferior to a plane passing from the inner canthi in a direction backward and downward to the mandibular angles give a better prognosis. This applies mainly to those cases in which the neoplasm originates from the alveolar process. In contrast the areas superior and posterior to the plane described offer a more difficult problem in management. I have seldom found neoplasms well localized anteriorly in the sinuses.

Diagnostic Methods

Roentgenologic study merits special mention as a diagnostic method because of the unsatisfactory rôle it plays in the interpreta-



Fig. 3. — Typical frog-face deformity brought on by an adult form of carcinoma of the ethmoids. The tumor tissue is presenting itself externally. The bilateral involvements while not of common occurrence present the most difficult therapeutic problems.

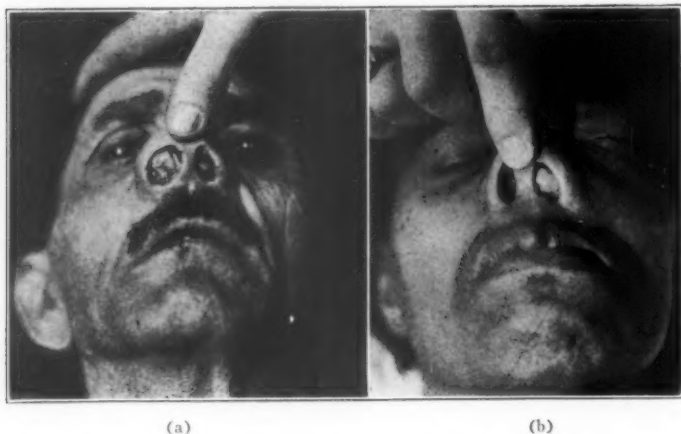


Fig. 4, a — Benign polyps presenting themselves in the anterior nares. They may be in such abundance as to cause deformity. Such tissue must be carefully biopsied to be authoritative; sectioning the tissue into the pedicle; b — Polyps in the anterior nares in a patient with a malignancy of the sinuses. Grossly they do not differ in appearance from the benign hyperplastic material.

tion of the invasive quality of the neoplasm. On many occasions we have found the tumor far more advanced than was shown by the gross changes in a careful radiologic examination (Fig. 2).



Fig. 5. — Sarcoma of the sinuses in a case of Paget's disease of the skull. The fleshy, easily bleeding tumor tissue is visible in the anterior nares. Both antra were involved by the neoplasm and the roentgenologic observation disclosed the presence of Paget's disease.

The means employed in the diagnosis of malignant disease of the sinuses are:

1. A careful history,
2. Inspection and palpation,
3. Auscultation,
4. Anterior and posterior rhinoscopy,
5. Endoscopy,
6. Transillumination,
7. Roentgen examination,
8. Radiopaques injected into sinuses,
9. Sinus irrigations,
10. Biopsy excisions.

This plan while complete is often insufficient for arriving at a conclusive diagnosis, every means of differentiation at our disposal being required in addition. The clinical picture of malignant neoplasms of the sinuses is so confusing that one must differentiate it from every entity producing pain, nasal obstruction and discharge, cranial nerve disturbances and swelling about the face. We have encountered numerous diagnostic vagaries, the symptoms of which have been enumerated (Fig. 5). Swellings about the orbit and face in themselves are significant and may be listed as:

- I. Congenital,
 - (1) Cephalocele,
 - (2) Dermoid,
 - (3) Angioma.
- II. Acute Inflammations,
 - (1) Erysipelas,
 - (2) Parotitis,
 - (3) Cellulitis,

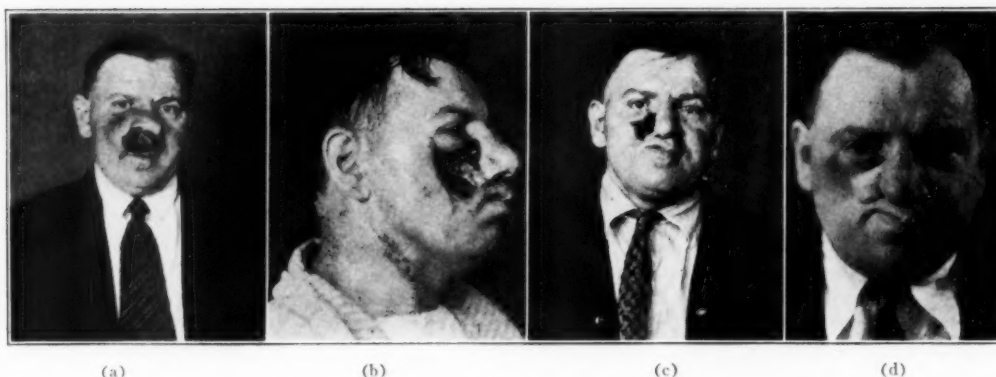


Fig. 6, a — Sarcoma of the antrum with infiltration of the skin and a massive tumor protruding from the right nostril; b — The external carotid was ligated and the entire right maxilla was removed by the electrosurgical method. The nasal septum and roof of the mouth of the other side are seen; c — One year following the operation the patient had been gaining weight and showed no evidence of recurrence; d — An Italian graft taken from the arm was brought up to close the defect in the cheek. Patient free from recurrence for more than seven years.

- (4) Dacryocystitis and dacryadenitis,
- (5) Fulminant sinusitis,
- (6) Rat bite fever,
- (7) Leukemia,
- (8) Cavernous sinus thrombosis,
- (9) Osteomyelitis of the jaw,
- (10) Trichinosis,
- (11) Phosphorous necrosis,
- (12) Poison ivy and forms of dermatitis,
- (13) Traumatic (emphysema).

III. Chronic Inflammations, Tumors, etc.,

- (1) Neurofibromatosis,
- (2) Leontiasis ossea,
- (3) Echinococcus cyst,
- (4) Tuberculosis,
- (5) Syphilis (periostitis and gumma),
- (6) Exophthalmos,
- (7) Xanthomatosis,
- (8) Neuroblastoma,
- (9) Chloroma,
- (10) Psammoma,
- (11) Cylindroma,
- (12) Rhinosporidium seeberi,
- (13) Osteoma,
- (14) Mucocoele,
- (15) Keloid,
- (16) Dermoid cyst,
- (17) Cavernous angioma,
- (18) Nephritis,
- (19) Nasopharyngeal fibroma,
- (20) Solid edema and angioneurotic edema,
- (21) Blastomycosis,
- (22) Hypernephroma,
- (23) Adamantoma,
- (24) Epulis,
- (25) Paraffinoma.

Management

Surgery, electrosurgery and irradiation combined, have given fair results in malignant tumors of the nasal sinuses, especially those of the antrum, in spite of the fact that 80 per cent have been termed inoperable because of invasion of vital structures. We have recommended the combining of radium therapy, roentgen ray and surgical removal of the parts whenever practical. We have always believed, however, that surgery was contraindicated when neoplastic involvement of the sinuses was bilateral.

Radium. In itself, radium has been unsatisfactory because of the difficulty of access to the growths and the resulting inflammatory changes which complicate the picture from a therapeutic standpoint. When the soft tissues of the cheek, including the skin, are infiltrated, they should be removed (Fig. 6, a, b, c and d). This permits inspection of the cavity over a period of months or years, facilitating future attack on any suspicious granulation tissue. Exposed osseous structures are slow in healing and often bony sequestra separate only after many months. Radium may be used in all of its forms but best by needles or radon seeds (intratumor), contact application (intracavitary), or as the pack or cannon. Interstitial application is uncertain and inaccurate and the tel-eradium application has to traverse too great a depth into osseous tissue to be effective. Furthermore, a study of the pathologic anatomy does not justify this method. After removal of the essential malignant mass radium is most effective when placed (2500 to 3500 millicurie hours) in the constructed cavity. In

addition, collar irradiation around the neck is also of definite merit.

X-Ray. In the sinus region, deep therapy (200,000 volts) has been found to be ineffective. We have employed it with discouraging results. The transitional types of cancer and the lymphoepitheliomas respond more favorably to x-radiation. These tumors although highly malignant, "melt away" under therapy (Fig. 7, a and b) but recur more prom-

neoplastic invasion. 2. The fact that the majority of the tumors are radioresistant. 3. The extreme difficulty and lack of certainty of irradiating tissue encased in bone and growing in many directions.

Surgery. We have employed radical electrosurgical resection, going wide of the growth and including osseous structure, and when indicated, the orbit and its contents. Block dissection of the lymphatic-bearing tissue of the



Fig. 7. a — Lymphoepithelioma of the sinuses invading the orbit and soft tissues of the cheek; b — Response to irradiation was almost immediate. While this tumor showed itself so radiosensitive it later recurred and became resistant to the rays.

inently than at first. They then respond with less sensitiveness to irradiation, or not at all, and ultimately lead to a fatal outcome. From such experience, it should be concluded that the x-ray dosage was interrupted for too great a time. Such growths (and perhaps all carcinomas as well) should be subjected to persistent radiation of maximum dosage, otherwise failure is inevitable.

The status of irradiation in general is by no means settled. I have employed the accepted methods painstakingly and openmindedly without success, but I am willing to withhold final judgment until more perfected techniques are offered. This applies to radium as well as to x-rays. I can see several major difficulties in regard to the use of irradiation in the treatment of cancer of the sinuses: 1. The inability to recognize the extent of the

neck has been performed as an important auxiliary measure. Before extensive surgery of these parts is done, ligation of the external carotid artery is essential. The removal of the invaded structures is followed by thorough electrocoagulation of the underlying and marginal tissues. X-radiation is applied both preoperatively and postoperatively and radium (3000 millicurie hours or more) is placed in the surgically formed cavity. Cosmetic results are not allowed to influence the necessity for radical procedures at this time of operation. If mutilation results, plastic reconstruction is performed afterwards. Rehabilitation is, of course, a vital consideration. Every effort is exerted for restoration by means of transplants, but when this is not possible, resort is had to prosthesis.

A careful surgical excision through healthy

tissues, with avoidance of morcellement and curettage, is the best means of approach for exposing the parts to be resected. In neoplastic infiltrations of the hard palate and alveolar process, electrocoagulation combined with radical resection of the osseous structures should be carried out. A wide external exposure is conducive to successful results when tumors invade the nose and its sinuses. Such an approach can be had by the sublabial route, as is usually employed in radical antrum surgery. After adequate exposure, the neoplastic mass is thoroughly electrocoagulated. Tumors which are more deeply situated and widely distributed must be exposed by external incisions along the lateral attachment of the external nose through the lip, occasionally along the infra- or supraorbital margin, depending upon the extent of neoplastic invasion. Electrosurgical excision is followed by coagulation of all lymphatic bearing tissue. The entire dissection should proceed with anatomical certainty, and at no time should a pulling or tearing morcellement technic be employed, as has been previously emphasized. Irradiation, or direct cavity application of radium, is the postoperative measure of choice.

Refinements in technic of electrosurgery have materially helped to minimize metastatic extension. If a percentage of cures was realized by the crude application of a hot soldering iron, the results should be far better today with the newer and improved equipment. Both electrosurgical resection and electrocoagulation should be carried out with the most careful surgical technic, otherwise recurrence or postoperative complications will ensue. Local and rectally administered forms of analgesia and anesthesia are ideally suited in electrosurgery.

Hautant, Monod and Klotz⁽⁴⁾ treated 21 cases of sinus neoplasms with 38 per cent. of cures, ranging from 4 to 11 years, by a combination of surgery and radiation. These authors, in a later report, have stated that the posterior ethmoid cells are most frequently involved, which accounts for extension into the antrum, orbit, pharyngeal vault, and in its terminal phase, the cribriform plate and the cranial cavity. Emphasis is made that when surgery is the sole method of treatment contemplated, the most radical procedures must be employed, such as resection of the superior maxilla and exenteration of the orbit. Even with such multilation, recurrence is common

and permanent cure is rarely seen. Results with surgical diathermy were no better, while cures by roentgen rays or radium alone were only occasionally observed. The necessity of avoiding damage to the ocular bulb, the danger of radionecrosis, the menace of an infected tumor in a closed cavity, and the radio-resistance of many of these tumors amply explain why cures are so few.

Complications of surgical and radiological treatment are postoperative meningitis when the meninges are invaded, as well as edema and abscess formation. There likewise may be orbital involvement due to extension of the tumor, and infection and softening of the bulb. Primary and secondary hemorrhage complicate the picture. Radionecrosis of bone is a factor in delaying the healing process and preventing the repair of the extirpated structures.

Conclusions

1. Malignant invasion of the sinuses may be active in the hidden osseous recesses long before symptoms draw attention to its possible presence.
2. Malignant neoplasms of the sinuses are characteristically infiltrative and seldom confined to the walls of a given sinus.
3. The term "primary," applied to a carcinoma in a given sinus, especially the antrum of Highmore, is misleading.
4. A tumor invaded sinus defies a certain definition of the origin of the neoplasm. More inclusive is the description, maxillo-ethmoidal carcinoma.
5. Because of their location neoplasms of the sinuses present symptoms which do not justify a diagnosis at the onset of the disease.
6. Investigation for purpose of diagnosis should include rhinoscopy, roentgenologic study and biopsy excision, all of which means frequently fail in determining the type of tumor or the extent of its invasion.
7. Diseases which cause pain, nasal obstruction, cranial nerve disturbances and swelling about the eye and face must be borne in mind in making a differential diagnosis.
8. Histologically all forms of epithelial and connective tissue tumors may be found in the sinuses, but the former are in preponderance.
9. Basically, therapy depends upon the histological structure of a tumor, but more decisively upon the rapidity with which it becomes infiltrative and metastasizing.
10. In the light of our present knowledge

the most adequate management combines electrosurgery with irradiation, first radically removing the neoplasm and its osseous attachments, followed by the application of radium in the surgically formed cavity.

11. Irradiation in itself in the treatment of malignant neoplasms of the sinuses leaves much to be desired.

12. Structures sacrificed in a thorough eradication of malignant growths of the sinuses may be restored by plastic operations or by prosthetic aids.

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Chemical Released by Nerve Carries Message to Muscle

A chemical released in certain nerves of the body every time a thought commands the nerve to move a muscle was described by Sir Henry Dale, director of Britain's National Institute for Medical Research. Sir Henry spoke at Indianapolis, Ind., at the dedication of Eli Lilly and Company's new research laboratories.

The message-carrying chemical is acetylcholine. Few people have ever heard of it. Yet it is the chemical that carries messages from some nerves to muscles. This performance was suggested by several researches in past years but the reality of the effect is only now being recognized. The theory contends that almost infinitesimal amounts of this chemical are released whenever there is a thought that commands a nerve to order a muscle to move.

Hundreds of times a second extremely small spurts of acetylcholine are produced in the body of an active person, each one bridging a gap from nerve to muscle.

It is hard to imagine the small amount of this chemical that is needed to act as chemical postman. Sir Henry computed that each outpouring spurt of acetylcholine consists of only three molecules. When he attempted to express its weight in grams, the scientific unit of weight that is one-thirtieth of an

ounce, he had to write 20 naughts to the right of a decimal point before a figure was reached.

If this chemical theory of how nerves control muscles really fits the facts, acetylcholine will be recognized as one of the most important substances in the living body, with possible potential usefulness in medicine.

Dr. Reid Hunt, of Harvard, was the first to point out the importance of acetylcholine about 20 years ago. Sir Henry Dale is one of the experimenters of nerve action. He finds some nerves act by giving off acetylcholine while others act by giving off adrenalin.

Sex, cancer, vitamins and virus diseases were linked together by Sir Henry.

Scientists have discovered that the sunshine vitamin D, coal tar products causing skin cancer, and both the male and female sex hormones have a type of chemical structure which shows them to be in the same chemical family.

In fact, Sir Henry explained, large doses of one of these substances will often act like one of the others, as when vitamin D is given in excess to female rats with the result that their sexual activity is quickened.

Even more startling is the discovery that the coal tar substances causing tumors in chickens seem to set up a cancer disease that becomes an infection.

ELECTROSURGICAL OBLITERATION OF THE GALLBLADDER *

MAX THOREK, M.D.

CHICAGO

In competent hands the classical removal of the gallbladder yields an immediate operative mortality, in selected uncomplicated cases, of 1 or 2 per cent. In hands not especially trained, particularly in complicated cases and in patients over 40 years of age, no such happy results are recorded. The mortality in surgery of the gallbladder in complicated cases still remains too high. The statistics of Enderlen and Hotz, based on 12,144 cases of biliary tract disease treated surgically by various competent operators, gave an immediate (global) operative mortality of 9.28 per cent. Verbrycke, quoting Lyons, states that in a review of a series of his cases in which operation was performed by first class surgeons the immediate mortality was 10 per cent, and there

were *serious hospital complications in 33 per cent*. Karl Meyer commenting on the mortality following cholecystectomy in unselected cases has asserted: "Those whose mortality in this class of cases is 'negligible' are most assuredly in the good graces of the gods. Most of us do not seem to be so favored." Table 1 is of interest in this connection. The greater mortality in males compared with females is striking.

Scalpel surgery of the gallbladder, therefore, must not be judged by the brilliant results of a few exceptional operators, but by the general results of the average surgeon (who often does not report his results). These may in many instances give immediate mortalities of 20 or 30 per cent or even higher.

The most frequent causes of death and complications following scalpel surgery of the bil-

* Read at the Thirteenth Annual Session of the American Congress of Physical Therapy, Philadelphia, September 12, 1934.

TABLE 1. — Mortality Statistics in Gallbladder Operations From 1908-1932

Surgeon	Number of Cases	Year	Mortality	Per Cent
1. Cotte, M.	Not given.	1908	Males	33
			Females	18
2. Davis, B. B.	563	1921		8.17
3. Enderlen and Hotz	12,144	1923		9.28
4. Brentano	280	1923	Males	36.78
			Females	17.29
5. Villard	131 cholecystostomies	1925	Males	34
			Females	21
6. Duclos	Global mortality	1926	Males	36
			Females	23
7. Boutin	18 cases complicated by perforation	1927	Males	71.43
			Females	27.21
8. Davis, B. B. ⁽⁷⁾	160 cases	1928		3.75
9. Cattell, R. B.:	311 cases (complications, 55 cases)	1929	Males	9.1
Ann. Surg. 89:932, (June) 1929			Females	6.8
10. Sanders, R. L.:	18 series of cases garnered from the literature totaling 60 cases	1930		15
Ann. Surg. 92:374, (Sept.) 1930				
11. Verbrycke ⁽⁸⁾	169 patients operated on by 23 surgeons; 1 surgeon in this series had 10 cases; another surgeon in this series had 20 cases	1927		8.8
				28.5
12. Tixier, Clavel and Chabannes	11 males 149 females	1932	Males	15
			Females	36.38
13. Thorek	649 cases 138 males 511 females	1910 to 1932	Males	16.8
			Females	9.4

iary tract are peritonitis, shock, hemorrhage, pulmonary embolism, pneumonia and cholemia. The first four are by far the most common and seem to be more or less inseparable from any form of scalpel surgery. In most instances they are directly traceable to biliary seepage, particularly from the bed of the gallbladder, which contains not only bile capillaries (often dilated) but also bile ducts of considerable caliber in from 15 to 25 per cent of individuals. These are injured during the course of scalpel cholecystectomy, and bile seepage results. Furthermore, it is not always possible to cover the denuded surface of the gallbladder-bed with peritoneum in a classic cholecystectomy. Bile, sterile or not, has been proved to act as a true chemical poison in the peritoneal cavity. Drainage invites bile seepage. Bakes observed bile issuing from the wound 230 times in 346 cases of simple cholecystectomy. He and many other surgeons were impressed by the post-operative appearance of bile in the dressing "in nearly all the cases."

Dangers of Drainage in Cholecystectomy

The dangers and evils of drainage are well known. Briefly, they are bile seepage (biliary peritonitis), hemorrhage (arrosion of vessels), cardiac embarrassment (particularly in the aged), acute dilatation of the stomach, pneumonia (usually right lobar) fistulas, hernias, evisceration, stenosing sequelae and the like.

There seems to be no doubt that a gallbladder operation without drainage has a better chance of success than if drained. Many of the dangers are eliminated by omitting drains. Theoretically, a dry field and a tightly closed abdomen are ideal, but a scalpel cholecystectomy with completely satisfactory peritonization cannot always be accomplished.

On the other hand, in certain conditions drainage is a necessity; for example, in cases of obstruction in the common bile duct, icterus, progressive septic cholangitis, inability to peritonize the cystic duct and gallbladder-bed and the like.

The logical answer as to how the evils of drainage may be remedied seems to be (a) by omitting drains, if possible, (b) by so protecting the gallbladder-bed that no bile leakage results, and (c) by eliminating the infected gallbladder. All these can be effectually accomplished by a procedure to be described.

The raw surface resulting from a dissec-

tion of the gallbladder from its bed is the *bête-noir* in cholecystectomy. Injury to the gallbladder-bed and the resultant division of bile passages nearly always result in biliary seepage. Bile seepage will not result from the divided cystic duct when it is thoroughly peritonized with serosa of the hepatoduodenal ligament. In view of these facts, elimination of seepage from the gallbladder-bed seems to be the keynote of the problem. I have shown that this can be effected by electrocoagulation of the entire thickness of the posterior wall of the gallbladder, and even the gallbladder-bed. This results in an occlusion (by coalescence) of the capillaries and bile ducts and by the formation of a dry, sterile layer of inert tissue. To this is added the covering of the electrocoagulated area with the ligamentum falciforme hepatis for further protection, while drainage is omitted.

Evolution of Author's Method

Pribram⁽¹⁾ states that surgeons preceding him practiced extensive partial cauterization of the mucous membrane of the gallbladder with the Paquelin burner for purposes of avoiding fistulas. He extended such "charring" or "burning" to larger areas of the gallbladder mucosa and called this procedure mucoclasia. As recently as 1933 and even more recently, 1934,⁽²⁾ he still speaks of "carbonization" of the mucosa of the gallbladder. Pribram has the following to say: "Originally, I used the Paquelin burner to destroy the mucous membrane. This proving ineffective, I used Hadenfelds' hot iron, such as is used in Bier's clinic. The burning effect is excellent. In spite of this it did not meet with the desired effects: first, because the heat introduced into the abdomen was too great; second, the danger of explosion." He then describes a diathermy apparatus designed by Keyser. It is surprising that even with the diathermic current at his disposal, Pribram still continues to speak of "charring and carbonization." His goal is "destruction of the mucous membrane." He continues: "One must not approximate the electrode snugly. One must just barely touch it and when sparking results the mucous membrane will be destroyed promptly. Avoid deep penetration."

From these statements it is self-evident that Pribram's mucoclasia is a procedure distinctly different from mine. I aim at the very opposite effects; viz., coagulation instead of car-

bonization; deep instead of superficial action; avoidance of carbonization (sparking) or "charring." My procedure calls for superimposition of the falciform ligament for protection and the avoidance of adhesions of contiguous viscera to the coagulated surface.

I have shown elsewhere^{(3), (4)} that cauterization of the mucous membrane of the gallbladder (mucoclasia) is insufficient to eliminate the gallbladder and eradicate disease. A charred eschar resulting from destruction of the mucous membrane acts, as do all eschars resulting from burns, as an impervious loosely attached foreign substance carrying with it the potential danger of partial or total detachment, which may result in hemorrhage, thrombosis and possible embolism. Albertin has shown that Pribram lost nine patients in a series of 310 cases in which mucoclasia was employed. Coupled with this drawback there is still another more important factor that the incomplete destruction of the gallbladder wall by carbonization defeats its purpose by permitting micro-organisms to remain dormant in the Rokitsansky-Aschoff sinuses. Carbonization is a superficial process. Carbonized surfaces slough and are often followed by secondary hemorrhages. Electrocoagulated tissues within the abdomen do not slough, do not bleed, but become encapsulated and finally resorbed. Electrocoagulation permits destruction of tissue to any depth desired, simultaneously sealing lymphatics, blood vessels and biliary canaliculi (Figs. 1-4 incl.). It leaves a dry, sterile, impervious surface tending to agglutination with serous surfaces. To be successful, destruction of the gallbladder wall must be thorough and extend through the entire thickness of the wall and as far into the tissues of the gallbladder-bed as conditions warrant.

Figures 5 and 6 are from two of a series of cases in which only destruction of the mucous membrane of the gallbladder (mucoclasia) was done. These prove the inefficiency of limiting the destruction to the mucosa in gallbladder disease. In my series of cases, mucoclasia was not followed by the anticipated clinical improvement. On the contrary, the condition of the patients became aggravated. Attempts at regeneration of the mucous membrane of the gallbladder were striking microscopic changes. Relaparotomy and cholecyst-electrocoagulectomy gave relief in many instances. Failure with subserous enuclea-

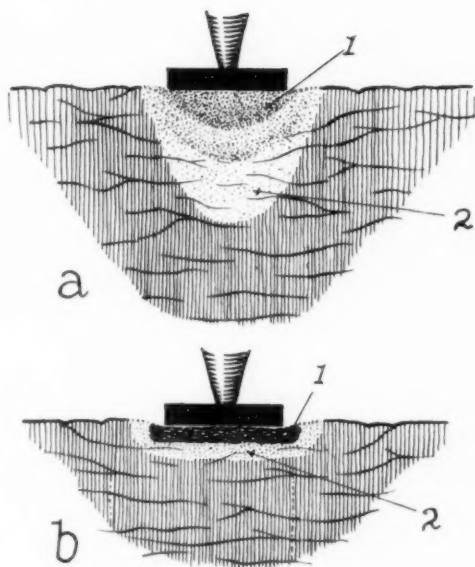


Fig. 1. — Diagram of effects of electrocoagulation and of carbonization. In (a) one observes the degree and extent of electrocoagulation when correct technic is used. The dense area immediately under the electrode indicates that here the action is of greatest intensity. It gradually decreases as indicated in the diagram. Marginal action is seen to extend for some distance from the border of electrode. When improperly used and too much current is applied charring results immediately under the electrode (b). Such eschar insulates the area acted upon and further effects of coagulation are frustrated.

tion of the gallbladder and with classic cholecystectomy led to the evolution of a method of total electrocoagulation of the gallbladder wall and the gallbladder-bed, with superimposition of the falciform ligament and the omission of drainage.

Rationale of Procedure

In patients seeking relief from symptoms of gallbladder disease, the surgeon often finds the gallbladder macroscopically normal at operation, but cholecystectomy frequently relieves these patients of their complaints. Histologically such gallbladders often contain diverticula, foci of infection, intramural abscesses and intramural calculi. The mucosal infoldings (Rokitansky-Aschoff sinuses) described by Luschka, in 1863, and later by Aschoff, in 1905, frequently harbor cholesterol concretions (stones); islands of round cells surrounding these diverticular outpouchings are commonly observed. Schmiedheiny concludes that "in all forms of cholecystitis the so-called liver bed is almost always affected." Here the pathologic processes transgress the tunica fibrosa and encroach on the subserosa and serosa, and frequently invade the contiguous liver

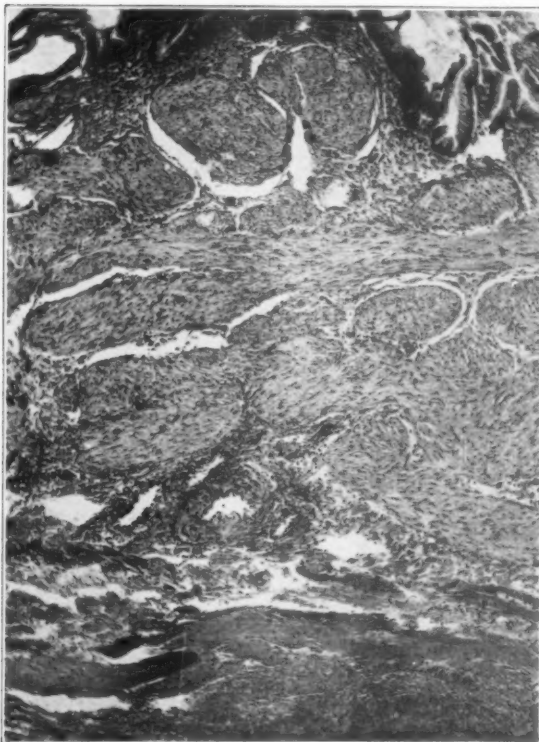


Fig. 2. — Effects of carbonization on gallbladder with chronic inflammation. Observe portion of Rokitansky-Aschoff sinus (right) persisting. Entire muscularis and serosa unaffected. Large vessel at bottom of section markedly engorged.

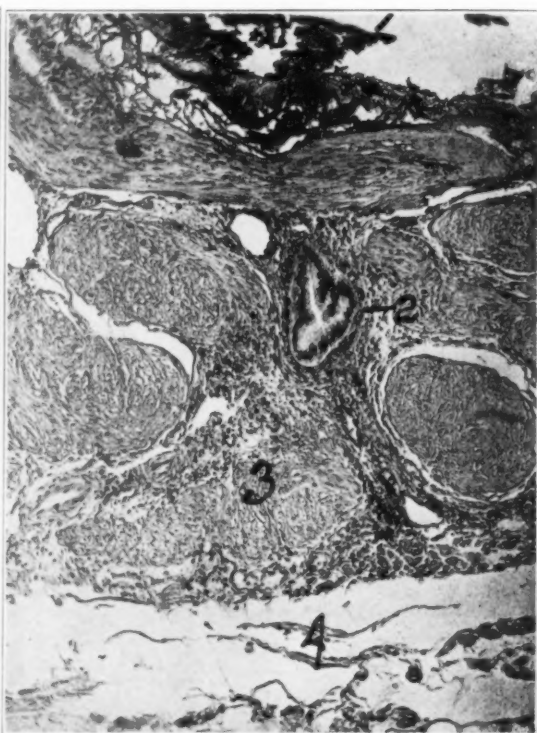


Fig. 3. — Effects of forced carbonization on wall of inflamed gallbladder. (1) Eschar. (2) Rokitansky-Aschoff sinus in transverse section. (3) Muscularis. (4) Serosa. Note excellent state of preservation of layers of gallbladder past the mucosa.

parenchyma, particularly in the more serious forms of gallbladder disease.

Electrocoagulation provides an efficient method of eradicating such foci. As shown by Zschau, the electrocoagulating current does not cause thrombosis in the blood capillaries and smaller vessels. The possibility of embolus is thus greatly minimized. When a coagulated area is peritonized there results a solid, more or less homogeneous, dehydrated, hyalinized mass which acts as a sterile tampon in the bed of the gallbladder; the tissues of such electrocoagulated areas tend to prompt healing by encapsulation and final absorption. Kuntzen and Vogel have shown that electrocoagulated areas of the liver in guinea pigs and dogs tend to prompt adhesions between the omentum, the coverings of the intestine, or any contiguous serosal surface. Adhesions thus formed were dense at the height of the reparative process but later tended to regress, and after some months "only a few fine strands connected the coagulated area with the omentum." I had occasion to substantiate

these observations in some of my experimental studies on the dog and macacus rhesus.

Electrocoagulation produces entirely different effects than thermocauterization or electrocauterization. Electrocoagulated areas on the surface tend to extrusion, while in the abdomen there result agglutination, encapsulation and absorption.

Electrocoagulation of liver tissue results in definite reactions. A zone of necrosis is observed at the point of contact with the electrode. This is limited by a line of demarcation consisting of leukocytes. Beyond this, another less extensive, zone of necrobiotic tissue is observed, which is again limited by a zone of leukocytes and wandering cells. From this layer encapsulation proceeds, and from within the protective connective tissue capsule absorption of the coagulated tissue takes place. Hemostasis as a result of diathermy does not take place by thrombosis, but by collapse and fusion of the walls of the vessels. According to Aschoff, coagulation-thrombosis is in sharp contradistinction to true thrombus formation.

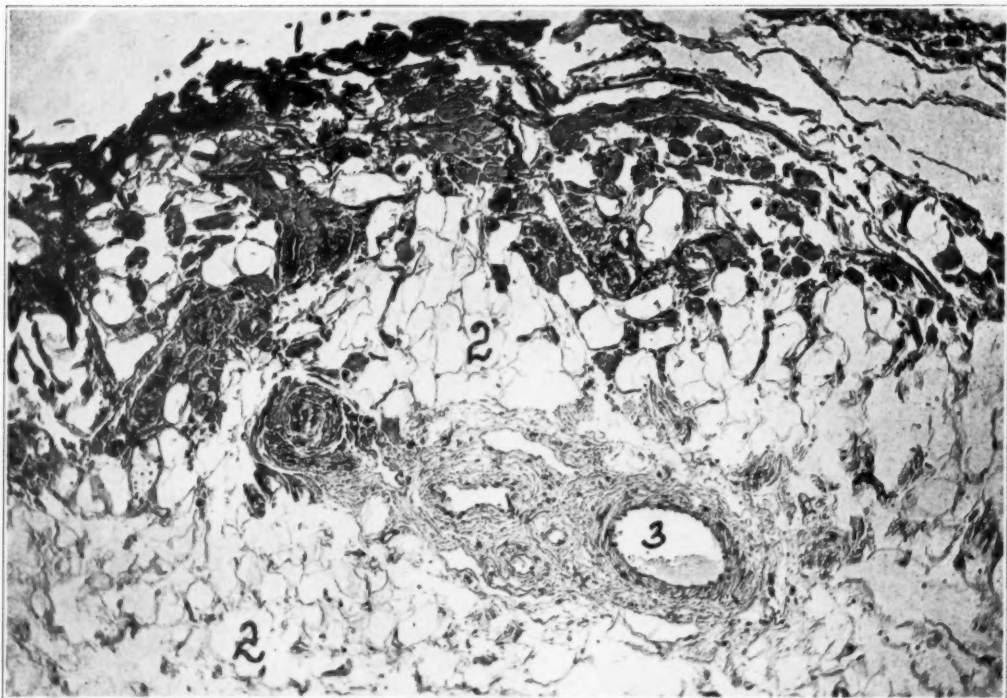


Fig. 4. — Effects of electrocoagulation on diseased gallbladder (chronic cholecystitis). 1. Destroyed mucous membrane. 2. Vacuolated spaces and homogenous islands of tissue the result of tissue dissolution and coagulation. 3. Blood vessel empty with small coagulum in lumen. Note, all layers are affected in the coagulating process.

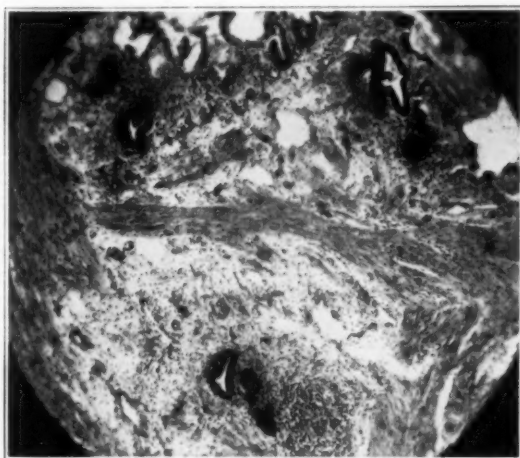


Fig. 5. — Reason for Failure of Mucoclasia. Mrs. A. M. Chronic cholecystitis eight months after (mucoclasia) electrocarbonization of the mucosa. Note remnants of Rokitsansky-Aschoff sinuses and diffuse round cell infiltration. Below in center of field an aggregation of polymorphonuclear leukocytes. Reduced from a photomicrograph with a magnification of 105 diameters. Persistence of symptoms. Relieved by total obliteration of gallbladder wall by electrocoagulation.

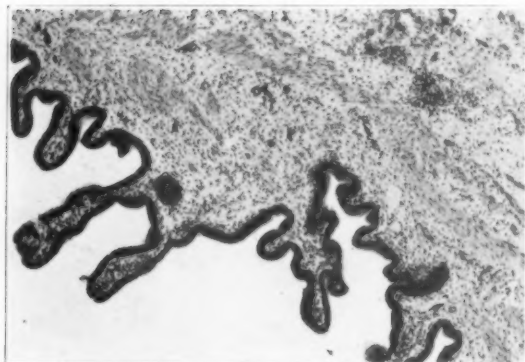


Fig. 6. — Reason for Failure of Mucoclasia. Mrs. M. L. Chronic cholecystitis nine months after electrocarbonization of mucous membrane of gallbladder (mucoclasia). No relief of symptoms. Regeneration of mucous membrane and persistence of inflammation (round cell infiltration, and the like). Relieved by electrocoagulation of entire gallbladder wall. Reduced from a photomicrograph.

Secondary hemorrhage does not occur because of the pressure exerted by the sequestered, coagulated mass against the connective tissue capsule.

Another important point to be remembered in using coagulating currents in the gallbladder-bed is: a coagulated depth of 3-5 mm. is not limited to that depth but actually to 2-3 cm. The practical deduction is to use judgment as to the depth of penetration required to obtain the desired results.

Kuntzen and Vogel have shown that encapsulation proceeds from Glisson's capsule and the periportal connective tissue which respond to the electrocoagulating process with development of young fibroblasts which encapsulate the coagulated material whence it is resorbed.

Shock is notoriously absent in electrosurgical procedures. Schörcher's⁽⁵⁾ studies are illuminating in this connection. Disraeli Kobak⁽⁶⁾ has shown that the absence of pain in electrocoagulated areas is explained by capping of the nerve ends by albuminoid substances which block afferent impulses.

Operative Technic

The operative technic has been fully described elsewhere. Briefly, it is as follows: General or spinal anesthesia (tropacocaine hydrochloride, 10 per cent; neocaine, or procaine); ample exposure, mobilization of the falciform ligament; aspiration of the gallbladder contents and exploration of the biliary passages; double ligation and division of the cystic duct and artery; removal of the redun-

dant part of the gallbladder wall by ordinary or special diatherm scissors. Only that portion of the wall of the gallbladder is permitted to remain which is attached to its bed. This is slowly electrocoagulated to the depth required (Fig. 7). Approximation of the edges of the coagulated gallbladder wall with catgut sutures. The previously mobilized falciform ligament is now superimposed over the coagulated area and kept in place by sutures previously left long (one on the cystic duct, the other at the upper end of the coagulated zone). No drains (Figs. 8 and 9).

In certain cases the entire gallbladder is removed as in classical scalpel cholecystectomy by means of acusection-coagulation. In other words, a current is used which divides and coagulates the tissue simultaneously. After ablation of the gallbladder, its bed is treated (electrocoagulated) as outlined above. The falciform ligament is superimposed and attached to the electrocoagulated surface. The abdomen is closed without drainage (Figs. 10 and 11).

A series of ninety-five patients were operated on by this method without a death. An analysis of this series is given in Table 2.*

TABLE 2. — Analysis of Ninety-five Cases*

Total number of cases.....	95
Males	9
Females	86
Age of patients — youngest.....	29 years
oldest	69 years
Average high temperature.....	100 F.
Average number of days in hospital.....	14.5

Pathologic conditions found at operation: Acute and chronic cholecystitis, cholelithiasis, hydrops vesicae fellae, empyema of the gallbladder, acute hemorrhagic cholecystitis, hepatitis, adhesions, pancreatitis (chronic).

Postoperative complications: None, except in one case in which a cholecystelectrocoagulectomy was done for gangrenous cholecystitis and cholelithiasis. The sutures were removed on the eleventh day. The wound healed by first intention. On the tenth postoperative day symptoms of bilateral pleurisy with effusion were noted, which cleared up. The patient left the hospital on the twenty-seventh day in good condition.

Mortality: None.*

Summary

(1) Failures and fatalities in classic cholecystectomy are frequently due to bile leakage, as a result of an inability to obliterate and cover the gallbladder-bed, which contains

* Compare with Table 1.

* Up to the present writing (April, 1935), 118 cases were operated on without a death.

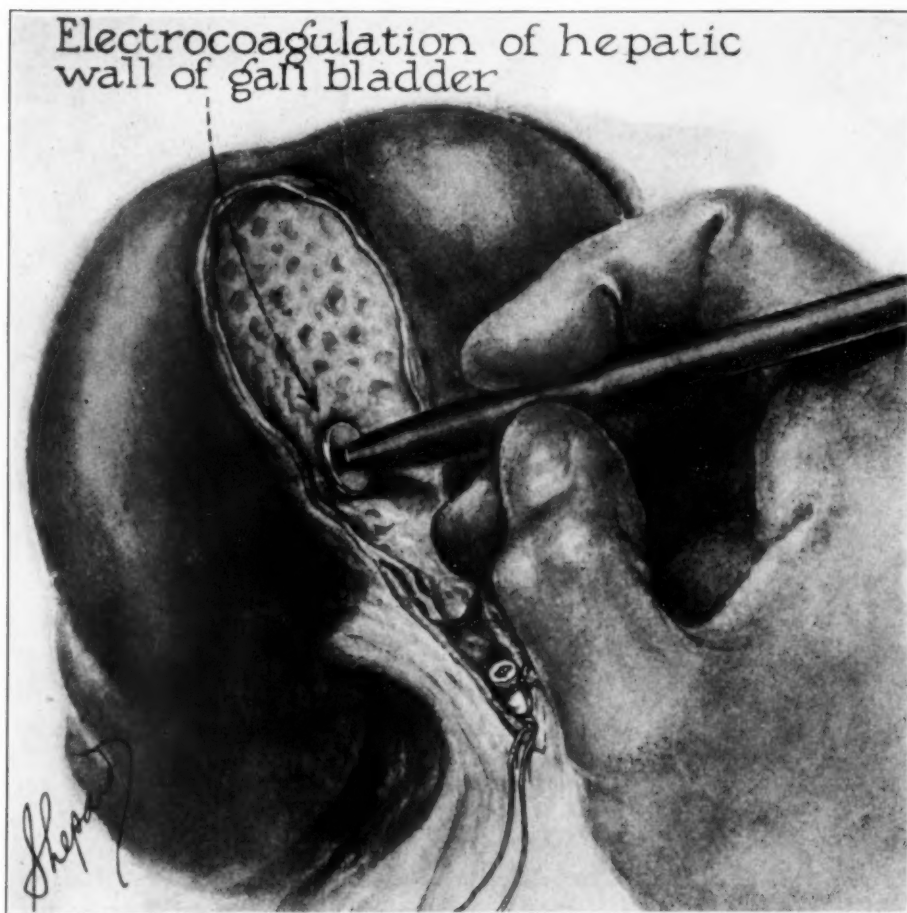


Fig. 7. — Redundant portion of the gallbladder is removed. Remaining portion of the gallbladder wall attached to the gallbladder bed is electrocoagulated.

bile capillaries and often larger bile ducts, in from 15 to 25 per cent of cases. Drains invite bile seepage.

(2) A method of electrosurgical obliteration of the gallbladder is described which, when carefully carried out, may be used in simple and complicated cases of gallbladder disease without resorting to drainage. It reduces morbidity and mortality to a minimum and shortens hospitalization. The much dreaded age factor in operations on the gallbladder loses its terror. Shock is absent. The term cholecystelectrocoagulectomy is descriptive of the procedure. It must not be confused with mucoclasia which aims at burning (carbonization) of the mucous membrane of the gallbladder and which is an entirely different procedure.

(3) A prerequisite to the achievement of

satisfactory results is a patent common duct. An occluded cystic duct from any cause is an indication for cholecystelectrocoagulectomy.

(4) Experimental studies have shown that any method of carbonization (fulguration, Paquelin or electrocauterization) predispose to hemorrhage, thrombosis and embolism. Such cauterization will not destroy pathogenic micro-organisms in the depths of the affected gallbladder wall. Cholecystelectrocoagulectomy is free from these drawbacks and effectually accomplishes destruction of the entire thickness of the gallbladder and gallbladder-bed. The surgeon has under control the degree of penetration he wishes to accomplish.

(5) The ligamentum falciforme hepatis is used as a pedicle or free graft in covering sutured or raw surfaces to great advantage, thus reinforcing and protecting the areas concerned

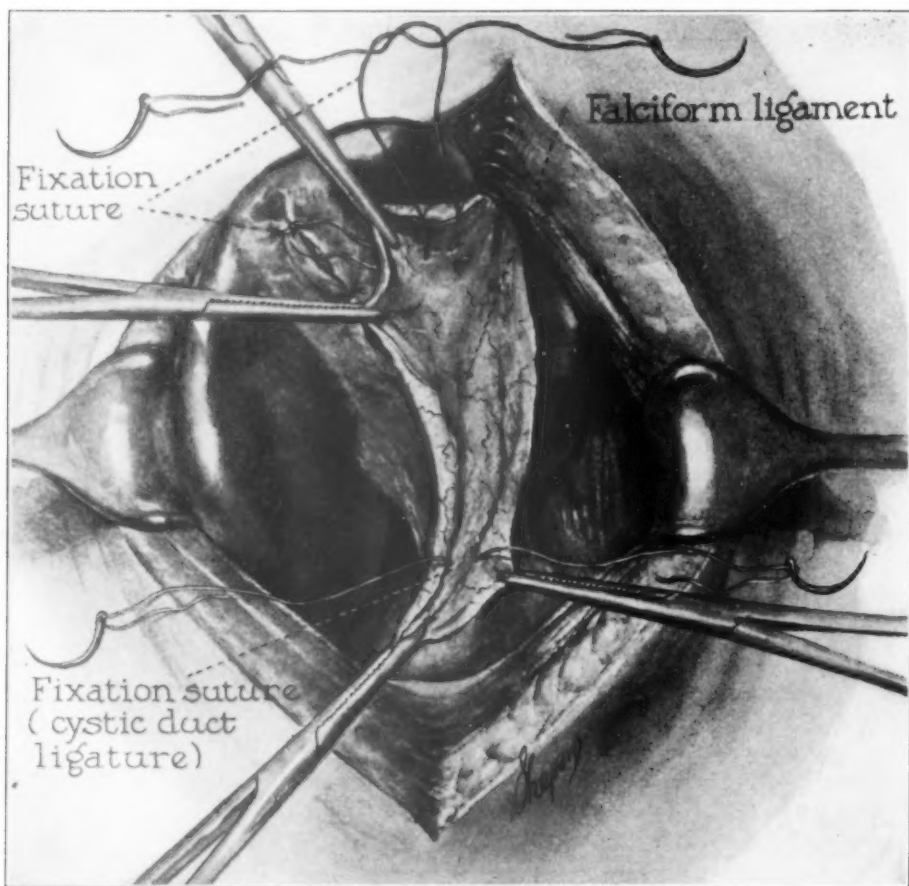


Fig. 8.—Note borders of the electrocoagulated area approximated with fixation suture. Additional interrupted sutures of fine catgut approximate the borders of the electrocoagulated zone along its entire extent. The mobilized falciform ligament is fixed over the closed, electrocoagulated surface. Note placement of sutures.

against seepage and safeguarding the processes of repair.

(6) Electrocoagulated areas in intra-abdominal organs tend to heal by encapsulation. They do not interfere with wound healing. On the contrary, they heal promptly when the wound is closed securely. Therefore, drainage is not only undesirable but is distinctly deleterious. Many patients succumb because of drainage. It prolongs the healing process and predisposes to infection. Cholecystelectrocoagulectomy eliminates the necessity of drainage and its unpleasant sequelae.

(7) This method when properly carried out substitutes for a leaking, unprotected, raw surface in the gallbladder-bed, a sterile, hyaline, dry protective layer.

8.) A series of 118 consecutive, unselected cases were thus treated without a fatality.

850 Irving Park Boulevard.

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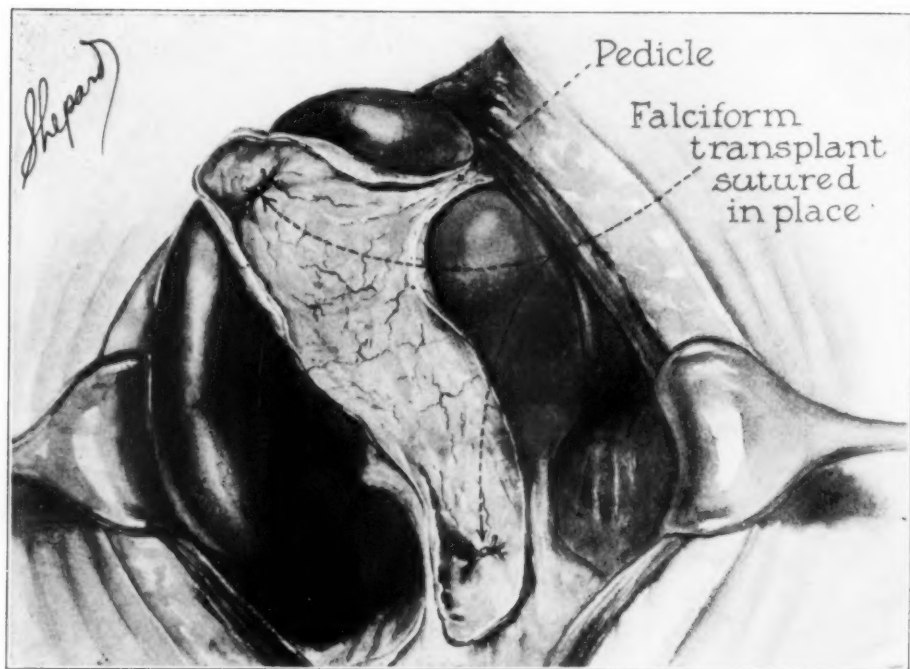


Fig. 9.—Appearance of electrocoagulated area after attachment of the falciform ligament.

Discussions

Dr. E. H. Trowbridge (Worcester, Mass.): Any surgeon pursuing this line of investigation should be thoroughly familiar with electrosurgery. It has been my custom to remove the gallbladder *in toto*. In Dr. Thorek's line of procedure, where the gallbladder is aspirated and the contents removed, thus shrinking the gallbladder and making it much easier to remove, to my mind is, or appears to be, an advance on the old line of technic. Inasmuch as by this method the remaining cystic wall of the gallbladder can be coagulated and the wall thus reduced to a practically non-infected area, certainly admits of coalescence of that surface by the deep stitches inserted to close the wound. Hence it is materially advantageous to close the wound without drainage. The elimination of drainage is, in my opinion, a most valuable procedure, although each case must be decided by the surgeon as to whether or not to adopt drainage. If it can be eliminated, it is very wise to do so. The surgeon in using electrosurgery in these cases is certainly warranted in adopting a different line of technic than where the scalpel is used. I am fully convinced that when the medical schools instruct their students, as they should be instructed, in electrosurgery, that the surgeons of the coming day will appreciate its use in most of their operations. For the past seven years we have used the electrosurgical outfit in practically 90 per cent of all our surgical operations.

Dr. Edward Kellogg (New York): Cholecystectomy as usually performed has not been uniformly satisfactory. The follow-up clinic and the gastroenterological clinics have revealed some of

the undesirable late results. There have been too many patients who have returned with digestive discomfort referred to the upper right quadrant, due to adhesions some of whom have required secondary operations, while the mortality in complicated cases is not negligible. In the classical cholecystectomy an attempt is made to save sufficient of the peritoneal covering of the gallbladder to cover the liver bed but it is so frequently friable and edematous that this procedure may be impossible or incomplete. Isolation and separate ligation of the cystic duct is usually followed by biliary discharge and this probability leads one to drain freely, which, in turn, prompts the formation of adhesions. A procedure that eliminates these complications should be welcome if adequate and safe. Dr. Thorek finds that the gallbladder bed contains bile ducts of considerable caliber, in 15 to 25 per cent of cases, and that these may be the source of biliary seepage when the gallbladder bed is denuded. While not able to give statistics, I have been impressed with the fact that this does occasionally occur, and have found that in acute conditions where the serous coat is edematous it is often impossible to avoid exposing the liver bed and opening an area for bile seepage, absorption of infection and promotion of adhesions.

I was impressed with the possibilities of Dr. Thorek's method and having equipped myself with the apparatus he uses, have followed his method in a selected group of cases as closely as possible and so far without fatalities and with uniformly good results. It is proper to state, however, that none of my cases have been of

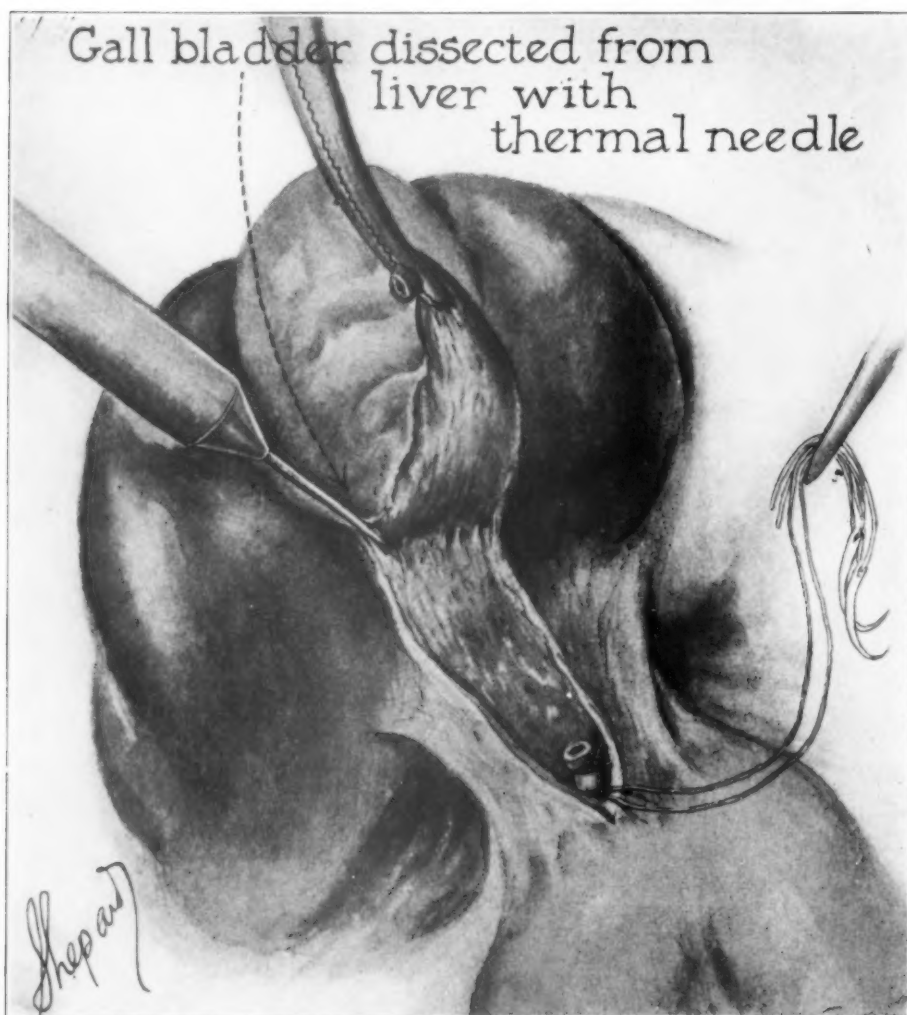


Fig. 10. — Gallbladder removed from its bed with the cutting coagulating knife.

the acute fulminant type, in which Dr. Thorek does not hesitate to use this method.

Increased experience gives increased confidence, however, and I hope soon to be able to report results in these more serious cases.

The special steps of Dr. Thorek's procedure, as I understand them are as follows:

1. Aspiration of the gallbladder making easier the manipulation of the viscus and opening the gallbladder for evacuation of its contents. The possibility of spreading infection by this method seems negligible in watching Dr. Thorek's careful technic but this I have found the most difficult step in his procedure to imitate. At this stage it is a comfort to recall that infection is found chiefly in the walls of the gallbladder and that only in a small percentage of cases is the bile actively infected.

2. Early ligation of the gallbladder pedicle, taking the cystic duct, artery and serosa in one circular ligature is time saving, affords a blood-

less field and renders negligible the possibility of delayed biliary seepage from the cystic duct, contrasting strongly with the dissection and separate ligation of the artery and duct.

3. Cutting away the gallbladder without removing the portion of the mucosa that is adherent to the liver bed.

4. Electrocoagulation rather than cauterization of the remaining mucosa. I have not always succeeded in preventing charring but this is due to faulty technic. In spite of this fact I have had no occasion to regret the results.

5. Covering over the stump of the cystic duct and the gallbladder bed with a portion of the ligamentum teres. This is not difficult and certainly diminishes the possibility of troublesome adhesions.

6. Closure of the abdomen without drainage. This has been the most difficult procedure to accept and in my first cases, lacking the courage of my convictions, I inserted a small drain

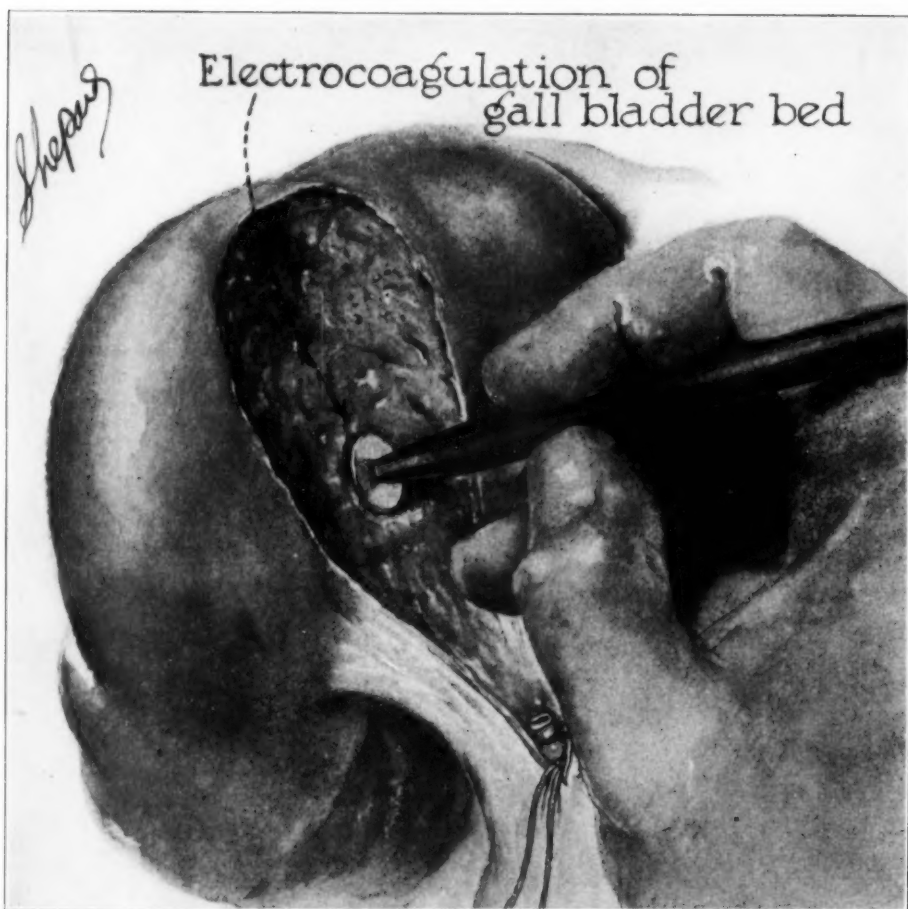


Fig. 11. — Direct electrocoagulation of the gallbladder bed after the gallbladder has been removed. This is followed by the further steps outlined in the previous procedure. (Approximation of borders of the electrocoagulated surface. Superimposition of the falciform ligament). No drainage.

through the peritoneum but removed it in a few days finding that it served no purpose except to aid my peace of mind. Recently I have closed a few cases without drainage and with satisfactory results.

I doubt if I shall bring myself to give up drainage in empyema of the gallbladder and I am not certain of Dr. Thorek's position in these cases.

He very properly states that drainage is necessary in obstruction of the common duct, icterus, septic cholangitis and inability to peritonealize the cystic duct and gallbladder bed. This last should be emphasized because the indications are possibly less obvious.

In conclusion I must say that in my small group of cases treated by this method there has been almost a total absence of the usual post-operative discomfort observed after classical cholecystectomy. Convalescence and the period of hospitalization is shortened and the ultimate results are so far uniformly satisfactory.

At the present time I am favorably disposed to the procedure but more time is required to

crystallize one's ideas and strengthen one's convictions.

Dr. Eugene St. Jacques (Montreal, Canada): Cholecystectomy as suggested by Dr. Thorek is surely a forward step toward more security in gallbladder treatment. Cholecystectomy is already a serious operation in itself and if greater efficiency can be added to our procedure, more good will ensue for the benefit of the patient. This new technic has given ample proof of its worthiness in the hands of experienced surgeons.

Of course, such a method as described by Dr. Thorek is not to be handled except by experts. They should be expert in abdominal surgery and especially in gallbladder work, expert also in the handling of electrical technical apparatus. We must not lose sight of the fact that only electrocoagulation is being sought and not electro-mortification of the tissues. Our aim must be security to the patient against any untoward effects or sequelae and this the essayist has demonstrated in a most impressive manner.

Dr. Moses Behrend (Philadelphia): It has been mentioned here this afternoon that Dr. Thorek

has not exactly stated his position concerning those cases of empyema of the gallbladder. They are, to my mind, the most important to handle in gallbladder surgery.

The question of mortality depends on how the cases of empyema of the gallbladder are handled. It has always been my rule, especially in the past 15 or 20 years, never to operate on a case of acute empyema of the gallbladder until the symptoms have subsided. I think that our mortality will again climb if we adhere to the principles that were laid down by the American Association of Surgeons, in Washington, D. C. Some of the best men in the country spoke about the operation on acute empyema of the gallbladder and advised immediate operation. I am absolutely against it because I am sure the mortality will be frightful again if this procedure is followed.

We are averaging about two gallbladders a week. In the past three years we have lost one case from cholecystectomy, which I think is a rather unusually low rate of mortality. We always adhere to that principle, that acute empyema of the gallbladder should not be operated on immediately.

I will be very much interested indeed to go to Chicago and see Dr. Thorek use the technic that he has described today.

Dr. Max Thorek (closing): Dr. Behrend is to be congratulated on his one per cent mortality. I attribute this low mortality rate to his special skill and to his expert anatomic knowledge. It

has been shown that 70 per cent of all individuals have abnormalities in either the vascular apparatus or the biliary tract. If a master operates and knows how to avoid pitfalls, he has such a small mortality. But, are all gallbladder operations done by the experts? They are not, I am sorry to say. The average man in a small town who has to do emergency work has to do it not as a matter of choice but as a matter of compulsion. There is where our mortality rates arise.

The statement regarding acute gallbladder and the desirability for immediate operation, I concur in wholeheartedly. In our clinic at the American Hospital, and at the Cook County Hospital we treat gallbladders as we treat pus tubes. In days gone by we operated and lost our patients. Today we let them "cool off" and hence do not lose them. We are conservative and we operate on clear-cut, specific indications.

With reference to empyema, I have no hesitancy, after the cooling-off process to use the same technic as I use in the cold case, with gratifying results. The acute gangrenous variety of gallbladder is also treated in the very same fashion.

Dr. Kellogg reported this afternoon cases with no mortality. It is very interesting to listen to such statistics. I hope that when Dr. Behrend returns to Philadelphia from his contemplated visit to my clinic in Chicago he may have a kind word for this procedure. I would not like to have it fall by the wayside, unless it has not proven worth the effort, and then I want it to die promptly.

The Pacific Physical Therapy Association

The regular monthly meeting of the Pacific Physical Therapy Association was held at the Hollywood Hospital, Wednesday, April 17, 1935, and the following program presented:

HYPERPYREXIA SYMPOSIUM CONTINUED

1. "The Physiology of Fever Therapy and Differential Indications for the Use of the Various Methods (Illustrated)."

By: Dr. J. Ross Moore of Los Angeles.

Discussants: Douglas R. Drury, Professor of Physiology, University Southern California; Rodney F. Atsatt, M.D., Santa Barbara; Robert C. Burt, Ph.D., Pasadena; Fred B. Moor, M.D., Loma Linda.

Dr. R. J. Behan Honored

Dr. R. J. Behan of Pittsburgh, Penna., and a member of the Congress has recently been elected President of the Allegheny County Medical Society.

Experts Find Pneumonia Deathrate Unusual

Figures for pneumonia deaths per 100,000 of the population during the last few years have surprised health experts. Something apparently has happened to the affinity between pneumonia and influenza deathrates.

High deathrates for these two diseases usually go together, but during the year just ended and also during the year 1932, the picture was reversed, statisticians of the Metropolitan Life Insurance Company report.

In 1934, reports from all over the country showed the lowest number of influenza cases in many years and the influenza mortality rate among the insurance company's industrial policy holders was one-half that of the previous year. Contrary to expectation, however, there was a pronounced increase in the pneumonia deathrate in the United States. On the other hand, 1932 began with an influenza epidemic and closed with the lowest pneumonia deathrate on record up to that time. — *Science News Letter*, January 19, 1935.

VENTRICULOCORDECTOMY WITH SURGICAL DIATHERMY

(Case Report)

M. H. COTTLE, M.D.

CHICAGO

In the encyclopedic work edited by Jackson and Coates, Irwin Moore surveys the treatment of bilateral abductor paralysis of the larynx. Moore describes nine operations, Chevalier Jackson's ventriculocordectomy, being held as the most encouraging one. This operation consists of excision of the cord and its supporting tissue forming the floor of the ventricle of Morgagni. Jackson performs this procedure endoscopically and employs a special punch forceps of his own design. Good results are reported in seven out of eighteen cases. The failures were due to cicatricial stenosis subsequent to operation.

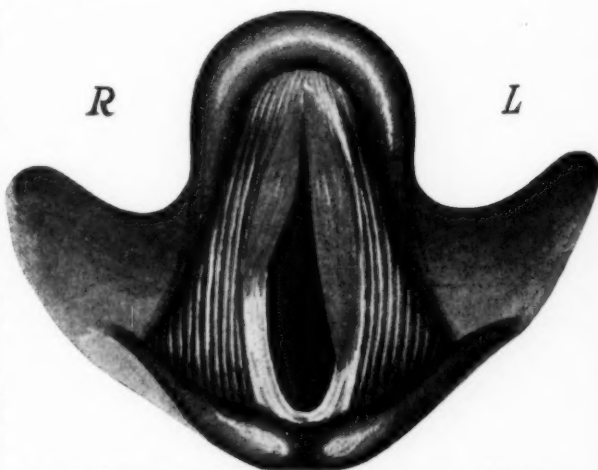
The following case is cited because it illustrates an effective method of cord destruction by electrocoagulation:

Mrs. A. J., age 50, presented herself in April, 1929, for the relief of difficult breathing, especially on inspiration and markedly aggravated by any exertion. This difficulty was definitely noted in October, 1928, within two weeks after a secondary thyroid operation. Examination of the larynx showed vocal cords in fixed apposition in the mid-line. The patient was treated conservatively for one month without any change. Consultation was held and excision of the cord advised. The patient was not seen again until August, 1929. She now presented herself in a rather desperate state. She wore a tracheotomy tube which had been introduced while she was in St. Louis the month before. Considering that with surgical diathermy in and about the larynx objectional scar formation has not been encountered, partial destruction of the vocal cords with this method was attempted.

Accordingly, on August 23, 1929, under local anesthesia the posterior one-fourth of the left and right vocal cords was destroyed with surgical diathermy. There was practically no reaction after three days when a triangular space was observed posteriorly between the vocal cords. The tube was then removed from the trachea. As there was still inadequate space for effortless respiration about half of the right vocal cord was extirpated in September, 1929. Again this was done endoscopically under local anesthesia and again there was no appreciable reaction.

Since these procedures the larynx has been inspected frequently and up to this time (February, 1935) there has been no scar formation nor stenosis from other causes. The patient works regularly, breathes freely even on exertion, has gained markedly in weight and has a very loud easily heard whispering voice.

The sketch shows approximately the condition of the larynx five years and five months after the operation. It is interesting also to notice that the anterior parts of the vocal cords are still in apposition.



Larynx five years and five months after operation showing remaining anterior half of right vocal cord and anterior three-quarters of left. Note adequate breathing space in posterior half of glottis.

Comment

Ventriculocordectomy is a procedure which is not commonly performed but when it is indicated, surgical diathermy possesses definite advantages over the punch operation. The chief advantage is in the absence of scar formation, which obviously is not only desirable but very essential in and about the laryngeal structures. The incidence of cicatricial stenosis is virtually altogether avoided.

30 North Michigan Avenue.

MUSCLE EXAMINATION IN POLIOMYELITIS *

A. M. RECHTMAN, M.D., F.A.C.S.

AND

HENRY SIGMOND, M.D.

PHILADELPHIA

A detailed examination of the individual muscles is essential in the care of a patient with poliomyelitis, both for immediate treatment and the determination of progress. Our muscle chart I is valuable as a guide in such examinations, because it describes the manner of eliciting the action, the function, the chief points of origin and insertion and the nerve supply of the muscles. Only the most important muscles for major function have been charted. The muscle or group primarily concerned with a particular motion has been chosen.

* From the Orthopedic Service of the Senior Author at the Jewish Hospital, Philadelphia, Pa.

en. If this muscle is active, the part may function, but if paralyzed, the associated or accessory muscles cannot efficiently perform the action.

The muscles are tested for their ability to perform their normal function, against the force of gravity, and against active resistance. The muscles may be graded as paralyzed or minus (—), weak or almost completely paralyzed or plus minus (±), faint trace of power or plus (+), weak but active two plus (++) , active or three plus (+++) and normal or four (++++) .

CHART 1.—Muscle Examination

Facial and Neck Muscles

Facial Muscles

Muscle	How Elicited	Function to	Origin and Insertion	Nerve Supply
Occipitofrontalis	Wrinkle forehead Raise eyebrows	Wrinkle brow	O. Superior nuchal line I. Skin in region of eyebrows	Facial
Orbicularis palpebrarum	Close eyelids tightly	Close eyelids	O. Nasal process sup. maxilla crest of lachrymal bone I. Tarsal plates and eyebrows	Facial
Levator anguli oris	Raise corner of mouth Blow through corner of mouth	Elevate the angle of the mouth	O. Canine fossa below the infra-orbital foramen I. Angle of the mouth	Facial
Depressor anguli oris	Pull the corners of the mouth downward	Depress the lower lip	O. Ext. oblique line of the mandible I. Muscles and skin at angle of mouth	Facial
Orbicularis oris	Blow or whistle	Close or constrict lips	O. Circular group of muscle fibers about the mouth I. Into the same	Facial
Masseter	Chew	Lift lower jaw	O. Ant. and mid. part of zygoma I. Outer surf. of ascending ramus and the angle of the mandible	Masseter

Neck Muscles

Sterno-cleido-mastoid	Turn head to the side Flex the head	One muscle turns the face to the opposite side and up Both draw the head forward and down	O. 2 heads, Ant. surf of manubrium and upper surf of internal end of clavicle I. Mastoid process and nuchal line	Spinal accessory
Rectus capitis lateralis	Tilt the head to the side	Bend the head to side	O. Sup. surf. of the transverse process of the atlas I. Inf. surf. jugular process of the occipital	Branch of cervical plexus
Rectus capitis anterior	Flex the head	Bend the head forward	O. Lateral mass and trans. proc. of the atlas I. Basal process of the occipital	Branch of cervical plexus

Muscles of Deglutition

Buccinator	Puff out cheeks	In mastication force food between the teeth from area between teeth and cheeks	O. Alveolar border of the maxilla and the mandible, of the molar teeth and the pterygo-mandibular ligament I. Orbicularis oris and angle of mouth	Buccal branch of facial
Levator palati	Say "ee" with the mouth open and see the soft palate elevate on one or both sides	Elevate the soft palate	O. Under surf. of the petrous portion of the temporal and cartilaginous portion of the eustachian tube I. Aponeurosis of the soft palate	Pharyngeal plexus
Uvulae	Say "ee" with the mouth open and see uvula rise	Elevate the uvula	O. Aponeurosis of the soft palate and posterior nasal spine I. Uvula	Pharyngeal plexus

*Muscles of the Upper Extremity**Shoulder Muscles*

Trapezius	Shrug or raise shoulder	Elevate shoulder Adduct arm above 90 degrees	O. Lig. nuchae. Occiput and spinous processes cervical and all dorsal vertebrae I. Posterior border of clavicle, scapular spine, and acromium	3rd and 4th cervical, spinal accessory
Latissimus dorsi	Pull arm to side and feel the posterior axillary fold Move the arm backward	Adduct the arm Extend the arm	O. Spines 6th to 12th dorsal vert. Lumbar and sacral spinous proc. Iliac crest and 9th to 12th ribs I. Intertubercular groove of the humerus	7th to 8th cervical
Pectoralis major	Pull arm to the side and feel the anterior axillary fold Turn arm in	Adduct the arm Internally rotate arm	O. Ant. border clavicle. Front of the sternum. Cartilage of the upper 6 ribs I. Greater tubercular ridge of the humerus	4th to 7th cervical, 1st thoracic
Deltoid	Adduct the arm from the side	Adduct the arm to 90 degrees	O. Outer third of the clavicle, acromium, lower border of spine of the scapula I. Outer side middle of humerus	Axillary (circumflex)

Rotator Muscles of the Shoulder

Internal rotators	See text			
External rotators	See text			

Muscles of the Arm

Biceps	Bend the elbow Flex the arm	Flex the forearm on the arm Flex the arm	O. Supraglenoid tubercle and coracoid of the scapula I. Tubercle at the upper end of the radius	Musculo-cutaneous
Triceps	Straighten the arm	Extend the forearm on the arm	O. Infraglenoid tubercle of scapula and 2 heads from the posterior aspect of the humerus	Radial (musculo-spiral)

*Muscles of the Forearm, Wrist and Hand**A. Flexors of the Wrist*

Flexor carpi ulnaris	Bend the supinated wrist forward and toward the body	Flex the wrist	O. Inner condyle of the humerus, side of the olecranon and the posterior border of the ulna I. Pisiform and 5th metacarpal	Ulnar
Flexor carpi radialis	Bend the supinated wrist forward and to the radial side	Flex the wrist	O. Inner condyle of the humerus I. Base of the 2nd and 3rd metacarpals	Median

B. Extensors of the Wrist

Extensor carpi ulnaris	Straighten (extend) wrist and bend toward the body	Extend wrist	O. External condyle of the humerus. Posterior border of the ulna I. Base 5th metacarpal	Post. interosseous branch of radial (musculospiral)
Extensor carpi radialis longior and brevior	Straighten (extend) and adduct the wrist	Extend wrist	O. External condyle and supracondylar ridge of the humerus I. Base of the 2nd and 3rd metacarpal	Radial (musculospiral)

C. Pronators and Supinators of the Forearm

Pronator radii teres	Turn the palm downward	Pronate and flex the hand	O. 2 heads-Coronoid process of the ulna and internal condyle of the humerus I. Outer aspect of the shaft of the radius	Median
Pronator quadratus	Turn the palm downward	Pronate the hand	O. Outer border of the ulna, lower $\frac{1}{4}$ of the oblique line of ulna I. Lower $\frac{1}{4}$ front, outer border of the shaft of the radius	Interosseous or median
Supinator longus	Turn the palm upward	Supinate the hand	O. Upper $\frac{3}{4}$ external condylar ridge of humerus: Intermuscular septum I. Styloid process of the radius	Radial (musculospiral)

D. Flexors of the Fingers and Hand

Flexor profundus digitorum	Hold the 1st and 2nd phalanges and bend the distal phalanges forward	Flex the distal phalanges 2 to 5 fingers	O. Anterior surface and posterior border of ulna I. Base of the distal phalanges 2nd to 5th fingers	Ulnar and median
Flexor sublimus digitorum	Hold the first phalanx and patient bends the middle phalanx forward	Flex the middle phalanges 2nd to 5th fingers	O. Inner condyle of the humerus: coronoid process of the ulna I. Sides of the middle phalanges 2nd to 5th fingers	Median
Flexor longus pollicis	Bend the distal phalanx of the thumb forward	Flex the distal phalanx of thumb	O. Anterior surface upper $\frac{1}{4}$ radius I. Base of distal phalanx of thumb	Median
Abductor pollicis	Pull thumb away from hand and forward	Abduct and flex thumb	O. Annular ligament. Ridge of trapezium I. Radial side base of proximal phalanx of the thumb	Median
Opponens pollicis	Oppose the thumb to the other fingers	Flex thumb	O. Annular ligament and palmar surface of trapezium I. 1st metacarpal, length of radial side	Median

E. Extensors of the Fingers and Hand

Extensor communis digitorum	Open the clenched hand	Extend the middle and distal row of phalanges, 2nd to 5th fingers	O. External condyle of the humerus I. Middle and distal phalanges 2nd to 5th fingers	Posterior interosseous of radial
Extensor indicis	Clench hand and straighten the 2nd finger	Extend the index finger	O. Dorsal aspect of the shaft ulna I. 2nd and 3rd phalanx of 2nd finger	Posterior interosseous of radial
Extensor minimi digiti	Clench hand and straighten little finger	Extend the 5th finger	O. Outer condyle of the humerus I. 2nd and 3rd phalanx little finger	Posterior interosseous of radial
Extensor longus pollicis	Straighten end of thumb from bent position	Extend distal phalanx of thumb	O. Dorsal aspect of ulna I. Base distal phalanx of thumb	Posterior interosseous of radial
Extensor brevis pollicis	Straighten the 1st phalanx of thumb from bent position	Extend the proximal phalanx of thumb	O. Dorsal aspect of the shaft of radius I. Base of proximal phalanx of thumb	Posterior interosseous of radial

F. Lumbricales and Interossei Muscles

Lumbricales	Separate the fingers	Abduct the fingers to either side of mid line	O. Tendons of flexor profundus digitorum I. Dorsal aspect of each finger into the extensor communis digitorum	1 and 2 from median, 3 and 4 from ulnar
Palmar interossei	Oppose the fingers	Adducts fingers to a line drawn through 3rd finger	O. 1st and 2nd from ulnar side of respective metacarpal. 3-4 from radial sides of 4-5th metacarpals I. 1st and 2nd into ulnar side base of 1st phalanx of corresponding digit. 3-4 in the radial side of the 4-5th digits	Ulnar
Dorsal interossei	Separate fingers	Abduction of index middle and ring fingers	O. 1st Proximal half, ulnar side 1st metacarpal and radial side of 2nd 2nd. Adjacent sides 2nd and 3rd metacarpal 3rd. Adjacent sides 3rd and 4th metacarpal 4th. Adjacent sides 4th and 5th metacarpal I. 1st. Radial side 1st phalanx in-	Ulnar

			dex finger and its extensor tendon 2nd. Radial side of 1st phalanx 3rd finger and its extensor tendon 3rd and 4th. Ulnar side of 3rd and 4th fingers in a similar man- ner	
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Abdominal and Back Muscles

External oblique	Patient recumbent. Flex thigh against resistance. Palpate muscle tension lower quadrant. Bear down, observe for herniation. Feel lower quadrant	Compress abdominal contents Flex trunk anteriorly and laterally	O. 5th to 12th ribs I. Anterior third of iliac crest ant. sup. spine and abdominal aponeurosis	8th to 12th thoracic, ilioinguinal and iliohypogastric
Transversalis	Side lying position. Fix pelvis. Flex trunk lateralward. Palpate loin. Observe for herniation	Pull ribs down to diminish size of abdomen Compress abdominal contents	O. Outer $\frac{1}{3}$ Poupart's lig., ant. $\frac{2}{3}$ of iliac crest, deep surf. 7-12 ribs, and trans. proc. lumbar vertebrae I. Linea alba, conjoined tendon into pubic crest	Iliohypogastric, ilioinguinal, 7th to 12th intercostal
Quadratus lumborum	Side lying position. Fix pelvis. Flex side lateralward. Herniation is transversalis not quadratus, if present	Steady the spine and twelfth rib. Flex the spine lateralward	Ant. layer. O. Trans. processes 5 to 2 lumbar vertebrae I. Inf. border 12 rib and body 12 thoracic vertebrae Post. layer. O. Int. iliac crest and iliolumbar lig. I. Inf. margin 12 rib and trans. process 4 to 1 lumbar vertebrae	Muscular branches lumbar plexus
Internal oblique	Patient recumbent. Pushes with hand diagonally across body against examiner's hand. Feel muscle tension upper quadrant same side	Compress abdominal contents Flex and rotate trunk	O. Outer $\frac{1}{2}$ Poupart's lig., ant. $\frac{2}{3}$ iliac crest, lumbar fascia I. 10th to 12th ribs post., 7th to 9th ribs ant., linea alba, conjoined tendon into pubic crest	Iliohypogastric, ilioinguinal and 6th to 12th intercostal
Rectus abdominis	Patient recumbent. Roll pelvis backward. Bend head and shoulders forward in bending trunk on thigh. Feel the tension in muscle	Compress abdominal contents Flex trunk	O. Symphysis and crest of pubis I. 5th, 6th and 7th ribs	6th to 12th intercostal
Psoas Magnus	Described later			
Erector spinae group 1. Iliocostalis (sacrospinalis group) 2. Longissimus 3. Spinalis	Straighten back from flexed position. Bend side to side and rotate trunk without moving the feet. Patient in prone position raises the trunk	Extension of spine and hold the trunk erect	O. Spines of the lumbar vertebrae, post. surf. of sacrum, crest of ilium and lumbar fascia I. By progression upward into the spinous and trans. proc. of the vertebrae, finally the ribs, occiput and mastoid	Dorsal division of spinal

Muscles of Respiration

External intercostals (11 pairs each side)	Inhale. Raise chest	Raise the ribs	O. Outer border of groove, lower border of each rib I. Upper border of rib below	Intercostal
Internal intercostals	Inhale. Raise chest	Pull ribs upwards	O. Inner lip groove in the lower border each rib I. Upper border of the rib below	Intercostal
Diaphragm	Inhale	Inspire	O. Inner surf. ensiform cartilage, bony part of 6 lower ribs in front, 2 thin tendinous arches from front of bodies of lumbar vertebrae I. Central tendon, highest part of diaphragm	Lower 6 intercostal, phrenic

*Muscles of Lower Extremities
Muscles of the Hip and Thigh*

Psoas magnus	Sit erect from the reclining position	Flex the trunk on thigh when the thigh is fixed and vice versa	O. Body 12th dorsal, body and transverse processes of lumbar vertebrae I. Lesser trochanter of femur	2-3-4 lumbar
Tensor fascia femoris	Approximate thigh to abdomen with knee flexed and feel muscle below the ant. sup. spine	Flex thigh (inward rotate)	O. Anterior 2 inches of iliac crest I. Fascia lata middle third of thigh	4-5 lumbar 1st sacral

Adductor longus	Approximate thighs	Adduct thigh and evert	O. Front of the body of os pubis I. Linea aspera mid. $\frac{1}{2}$ of femur	Obturator (2 and 3 lumbar)
Adductor brevis	Approximate thighs	Adduct thigh and evert	O. Front of descending ramus pubis I. Upper third of linea aspera	Obturator (2 and 3 lumbar)
Adductor magnus	Approximate thighs	Adduct thigh and evert	O. Ischium and inf. ramus of pubis I. Linea aspera and int. condyle femur	(Obturator (2 and 3 lumbar)
Gluteus medius	Separate thighs	Adduct thigh. Rotate thigh inward	O. Outer surf. ilium between crest and upper curved line I. Great trochanter of femur	Sup. gluteal (4-5 lumbar)
Gluteus maximus	Hyperextend thigh from prone position. Extend thigh from flexed attitude	Extension of thigh	O. Post. fifth iliac crest, dorsum of sacrum and coccyx I. Fascia lata and ridge great trochanter to linea aspera	Inferior gluteal
Medial rotators of hip	See text			
Lateral rotators of hip	See text			

Muscles of the Knee

Rectus femoris	Straighten flexed leg	Extend the leg on thigh	O. Anterior inferior iliac spine and groove above the acetabulum I. Through patellar tendon into tibial tubercle	Anterior crural (3-4th lumbar)
Biceps (outer hamstring)	Bend the leg on thigh and feel tendon on outer lower posterior aspect of thigh	Flex leg on thigh. Externally rotate	O. Tuberosity of ischium. Lower $\frac{2}{3}$ of linea aspera I. Head of fibula	Great sciatic (5L, 1, 2, 3-S)
Semitendinosus	Bend the leg on thigh and feel the tendon, inner lower posterior aspect of thigh	Flex leg on thigh	O. Tuberosity of ischium I. Upper part of inner surface of tibia	Great sciatic
Semimembranosus	Bend the leg on thigh and feel the tendon, inner lower posterior aspect of thigh	Flex leg on thigh	O. Tuberosity of ischium I. Posterior aspect of inner tuberosity of tibia	Great sciatic

Muscles of Leg and Foot

Flexor longus digitorum	Straighten or hyperextend the toes. Raise foot	Extend 1st to 4th toes and dorsal flex the foot	O. Outer tuberosity and upper $\frac{3}{4}$ ant. surface of fibula I. By 4 tendons into 2nd and 3rd phalanges 2nd to 5th toes	Anterior tibial (4, 5L and 1S)
Extensor proprius hallucis	Straighten or hyperextend the big toe	Extend the great toe	O. Mid. $\frac{2}{4}$ ant. surface of the fibula I. Base of the distal phalanx of great toe	Anterior tibial (4, 5L and 1S)
Gastrocnemius (calf m)	Point foot downward	Extend foot (plantar flex)	O. Posterior aspect of the condyles of the femur and bony surface above I. Through the tendo achillis to os calcis	Internal popliteal (1, 2, 3S)
Peroneus brevis	Pull foot from the midline	Abduct and evert the foot	O. Lower $\frac{2}{3}$ outer surface of the fibula I. Outer side of the base of 5th metatarsal	Musculocutaneous (4, 5L, 1S)
Peroneus longus	Pull foot from the midline	Abduct and evert the foot	O. Upper $\frac{2}{3}$ outer surface of the fibula I. Base of the 1st metatarsal and under and outer aspect of external cuneiform	Musculocutaneous (4, 5L, 1S)
Tibialis anticus	Pull foot up and in	Dorsal flex and invert the foot	O. Upper $\frac{2}{3}$ outer surface of tibia I. Internal cuneiform and base of metatarsal inner side	Anterior tibial
Tibialis posticus	Pull foot down and in	Plantar flex (extend and invert)	O. Adjacent surfaces of tibia and fibula at mid $\frac{2}{3}$ I. Tuberosity of scaphoid and internal cuneiform	Posterior tibial

Lumbricales and Interossei Muscles

Lumbricales (4 muscles)	Flex first, then straighten the end phalanges 2nd to 5th toes	Flex proximal and extend 2nd and 3rd phalanges 2 to 5 toes	O. Adjacent sides of long flexor tendons except the first whose origin is inner side tendon of 2nd toe I. Inner sides of tendons of ex- tensor longus digitorum 2nd to 5th toes	Internal and ex- ternal plantar
Interossei dorsalis (4 muscles)	Separate the toes	Abduct the toes from midline of 2nd toe	O. By 2 heads from adjacent sides of metatarsal bones I. Base of 1st phalanges and into extensor communis digitorum tendons on dorsum of toes	Internal and ex- ternal plantar
Interossei plantaris (3 muscles)	Appose the toes	Adduct toes to- ward the mid- line of 2nd toe	O. Inner sides and under surface 3rd to 5th metatarsals I. Respectively into inner sides of bases of 1st phalanges 3rd to 5th toes, and common extensor ten- dons	Internal and ex- ternal plantar

Upper Extremities

If a muscle of the upper extremities is weak the patient may be unable to make it function against the force of gravity. In the examination of the upper extremity the deltoid may function when the patient is reclining (Fig. 2) but not when the patient is in the erect position (Fig. 1). The biceps, if weak, may not have sufficient strength to flex, on the arm, the extended forearm (Fig. 3), but with the arm held in right angle abduction (Fig. 4) and the forearm supported in a similar plane, the patient may be able to flex the elbow. The triceps, if weak, may not function to extend the forearm on the arm, if the arm is held in 180 degrees of abduction (Fig. 5), but may do so in an attitude similar to that used in testing the weak biceps (Fig. 6). With the wrist flexed the extensor muscles may be unable to extend the hand because of its weight and the influence of the force of gravity (Fig. 7), but if the hand is supported (Fig. 8) in the straight position, power may be detected in the extensor muscles.

The rotator muscles of the shoulder, even as the rotator muscles of the lower extremities, are concerned with the other motions of the part. It is, however, easier to designate one muscle as being chiefly concerned with the function of rotating the shoulder in or out, than to designate one hip muscle as being chiefly concerned in the function of either internal or external rotation. The pectoralis major and subscapularis muscles are the chief internal rotator muscles of the shoulder. These are aided to a lesser degree by the action of the teres major muscle. The infraspinatus is the chief external rotator of the shoulder and this function is aided by the teres minor muscle.

The Back and Abdominal Muscles

Power in the erector spinae muscles may be determined by the ability of the patient to hold the head erect, to hyperextend the head or back when in the reclining position, and to sit without the spine deviating from the midline, or from its normal anteroposterior attitude. The normal attitude of the spine also depends on the tone of the abdominal muscles. Activity of these muscles, viz., the rectus abdominis, quadratus lumborum, the obliques, internus and externus, and the transversalis are tested by noting the pressure exerted by them against the examining hand as the patient tries to distend the abdomen, cries or tries to sit erect (Fig. 9) from the reclining position. Herniation or pouching of a part of the abdominal wall is indicative of local muscle weakness (Fig. 10).

The abdominal muscles and the erector spinae are concerned in lateral bending. They are tested with the patient lying on the opposite side. The lower extremities and pelvis are fixed. The patient raises the head and shoulders from the table. When the patient is recumbent or prone and the pelvis is fixed, lateral bending may be attempted. In the same position abduction of the straight extremity may distinguish a difference in muscle strength between the quadratus lumborum and the other lateral abdominal muscles.

Lower Extremities

In the lower extremities the ability to sit erect from the reclining position indicates power in the iliopsoas (Fig. 11) muscles. The function of the tensor fascia femoris (Fig. 12) is elicited by ability to flex the thigh on the abdomen. This is done with the patient reclining, the leg flexed at a right angle over the edge of the examining table or bed, to

MUSCLE SKINEMATION CHART, NO. II

HEAD AND NECK		TRICEPS MUSCLE		EXTENSION MUSCLES OF WRIST AND FINGERS	
1. WEAK		2. ACTIVE		3. WEAK	
4. ACTIVE		5. WEAK		6. ACTIVE	
7. WEAK		8. ACTIVE		9. WEAK	
10. ACTIVE		11. WEAK		12. ACTIVE	
13. WEAK		14. ACTIVE		15. WEAK	
16. ACTIVE		17. WEAK		18. ACTIVE	
19. WEAK		20. ACTIVE		21. WEAK	
22. ACTIVE		23. WEAK		24. ACTIVE	
25. WEAK		26. ACTIVE		27. WEAK	
28. ACTIVE		29. WEAK		30. ACTIVE	
31. WEAK		32. ACTIVE		33. WEAK	
34. ACTIVE		35. WEAK		36. ACTIVE	
37. WEAK		38. ACTIVE		39. WEAK	
40. ACTIVE		41. WEAK		42. ACTIVE	
43. WEAK		44. ACTIVE		45. WEAK	
46. ACTIVE		47. WEAK		48. ACTIVE	
49. WEAK		50. ACTIVE		51. WEAK	
52. ACTIVE		53. WEAK		54. ACTIVE	
55. WEAK		56. ACTIVE		57. WEAK	
58. ACTIVE		59. WEAK		60. ACTIVE	
61. WEAK		62. ACTIVE		63. WEAK	
64. ACTIVE		65. WEAK		66. ACTIVE	
67. WEAK		68. ACTIVE		69. WEAK	
70. ACTIVE		71. WEAK		72. ACTIVE	
73. WEAK		74. ACTIVE		75. WEAK	
76. ACTIVE		77. WEAK		78. ACTIVE	
79. WEAK		80. ACTIVE		81. WEAK	
82. ACTIVE		83. WEAK		84. ACTIVE	
85. WEAK		86. ACTIVE		87. WEAK	
88. ACTIVE		89. WEAK		90. ACTIVE	
91. WEAK		92. ACTIVE		93. WEAK	
94. ACTIVE		95. WEAK		96. ACTIVE	
97. WEAK		98. ACTIVE		99. WEAK	
100. ACTIVE		101. WEAK		102. ACTIVE	

eliminate the accessory action of the quadriceps muscle. The abduction power of the gluteus medius muscle is tested by the patient's ability to abduct the thigh with the knee flexed

and the patient lying on the side (Fig. 13). If this muscle is weak its power may be elicited by the patient's ability to abduct the thigh when lying on his back, as this attitude

minimizes the effects of the force of gravity and the weight of the part (Fig. 14).

Power in the gluteus maximus in extending the thigh is tested for as in the first position mentioned for testing the gluteus medius (Fig. 13) and depends on the patient's ability to hyperextend the thigh (Fig. 16). With the patient in the prone position with the knee flexed (Fig. 15) his ability to lift the thigh from the bed into an attitude of hyperextension signifies greater power in the gluteus maximus muscle.

The rotators of the hip are muscles of more than one function and are also concerned with the function of abduction, adduction, flexion or extension. The function of rotation is secondary. If the chief flexor, extensor, abductor and adductor muscles of the hip are active, there is invariably good power of rotation and it is unnecessary to test the individual muscles of rotation. It is difficult to designate any one muscle as being the chief internal or external rotator. The internal rotator muscles of the hip are the iliopsoas, gluteus minimus, iliacus, tensor fascia femoris and the anterior fibers of the gluteus medius. The external rotator muscles of the hip are the posterior fibers of the gluteus medius and minimus, the piriformis, the gemelli and obturator muscles, the quadratus femoris, gluteus maximus, rectus femoris, sartorius, and the three adductor muscles of the thigh.

With the extremity in the attitude for testing the tensor femoris, good power in the quadriceps muscle (Fig. 17) is shown by the ability of the patient to straighten the knee. It requires less power to make the patella taut, lift the extended lower extremity, or, when the patient is on the side with the knee flexed, to straighten (Fig. 18). With the patient on the side and the leg extended the action of the hamstring muscles is shown by the power to flex the knee (Fig. 20). The active ten-

dons may be palpated at the bend of the knee. Greater power in these muscles is demonstrated by flexing the leg on the thigh when the patient is in the prone position (Fig. 19).

The ability to point the foot and toes downward and inward indicates power in the tibialis posticus (Fig. 21). The tendon of this muscle may be felt as it courses beneath the inner malleolus. Dorsiflexing the foot indicates power in the common extensor of the toes and the extensor proprius hallucis (Fig. 25). Activity in the tibialis anticus (Fig. 22) is elicited by the ability to draw the foot upward and inward. The peronei muscles abduct the foot (Fig. 23), and the calf muscle plantar flexes the foot (Fig. 24).

In infants and very young children much effort and patience may be necessary to elicit activity or power, especially if the muscles are weak. The determination of power is aided by tickling the part or irritating it with a sharp object (pin), so as to encourage the child to move the part. Asking the patient to move the part studied toward the finger of the examiner, helps in the examination (Figs. 21 to 25).

Conclusions

In studying patients with poliomyelitis, periodic muscle examinations are necessary. The early determination of the degree of paralysis is often difficult because of the marked toxicity of the patient and temporary generalized muscle weakness. Occasionally muscle weakness may not be apparent for a week or ten days after the onset of the disease.

An adequate and repeated muscle examination is desirable as too often treatment is neglected because in the gross examination, the weakness of a single muscle or muscle group in an extremity may not be detected and deformity or loss of function may result in damage either irreparable or only to be corrected by surgery.

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COMPARATIVE ANALYSIS OF HEAT PRODUCTION *

(Physical Analysis of High Frequency, Radio Frequency and Conductive Heat.)

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Research in the field of physical therapy has been productive of new apparatus, new designs of old apparatus, accessories, new "gadgets" yielding much information but also misinformation. It is hoped that this paper will help in separating facts from fallacies—for which purpose we have analyzed some of the current modalities of artificial fever production. Physical tests have therefore been made on individual machines. These tests and their results are presented for their physical rather than their therapeutic characteristics.

The market is filled with numerous diathermy and short wave apparatus, electric blankets, heat cabinets and the like. Most of the machines seem to produce results which differ little from each other. The question naturally arises, why is one instrument so much better than another and why should one be so much more expensive than another? The first we shall consider is the diathermy apparatus. We tested one of the more expensive instruments of the portable type. The short wave machine was next considered. Then an electric blanket, which compares the high frequency machines with a very simple device of a readily understood heating principle. We shall try to point out the engineering features which cause one machine to be superior to another to enable us to make selections suitable to our therapeutic needs as well as our economic considerations.

Diathermy

In this age of high engineering development, practically every line of endeavor leads straight to the goal—efficiency. Upon inspecting a new equipment the first query

of the engineering mind is: How efficient is the apparatus? For example, a steel plant considers a new blast furnace and immediately the question is raised: What is its efficiency? A bakery contemplating the installation of a new oven compares different makes to ascertain the most efficient. Likewise a physician considering a machine for human heating should be interested in its efficiency.

As a general definition, efficiency is the ratio of energy supplied to the amount of energy converted into useful work. Expressed in percentage:—

$$\% \text{ Efficiency} = \frac{\text{Energy output}}{\text{Total energy input}} \times 100.$$

It is evident that to determine the efficiency of a diathermy machine two quantities must be measured; namely, the total amount of power (energy) supplied, and the amount of power or energy that is delivered as heat to the patient. The first quantity, the total amount of power supplied to the machine can be measured directly by inserting a wattmeter in the input circuit to the diathermy machine. The measurement of the second quantity, the heat delivered to the patient, is slightly more complicated because it must be made at high frequencies. If we wish to measure the useful heat delivered to the patient by an application of Joule's Law, the circuit constants must be determined at the operating frequency. Voltmeters and ammeters for the range of frequencies encountered in the diathermy output are complex and difficult to use correctly, wattmeters for these frequencies are difficult to construct and calibrate and are subject to a multitude of errors.

* Read at the Thirteenth Annual Session of the American Congress of Physical Therapy, Philadelphia, September 10, 1934.

The method used in these tests is very simple, requires only the most elementary apparatus, and in spite of its simplicity is quite accurate. With a reasonable amount of care efficiencies correct to within one per cent or even better may be readily attained. The method requires the substitution of a calorimeter for the patient. The calorimeter is filled with an electrolyte of specific resistance so that the total resistance of the calorimeter approximates that of an average patient. Connections to the calorimeter are provided for by immersing two electrodes into the electrolyte. A thermometer is placed in the calorimeter. It is best to use an alcohol thermometer, since a mercury one is apt to spark on the inside and separate the mercury column or break the thermometer.

With this arrangement we are now able to determine the amount of current that is changed into heat within our synthetic patient. The diathermy is connected to the "patient," is turned on for a definite period, and the temperature rise noted. The diathermy machine is then disconnected and a small resistance coil is immersed into the calorimeter and the coil connected to a direct current source (6-volt storage battery). The current is allowed to flow through the resistance coil at a rate insuring a temperature rise at the same rate it did when the diathermy was connected. Hence by starting with the same quantity of water at the same initial temperature and running for the same length of time, the heat supplied in the two cases will be identical. A voltmeter and an ammeter placed in the direct current circuit permit accurate determination of the power supplied, according to the formula:

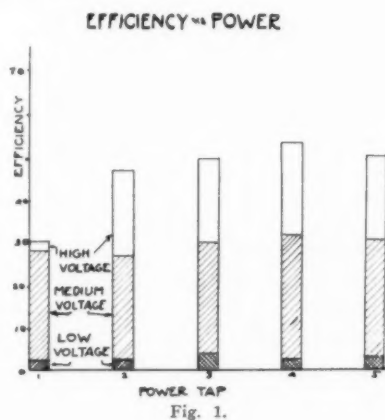
$$\text{Kilowatt hours} = \frac{\text{Volts} \times \text{Amps} \times \text{time}}{1000}$$

It is evident that this method is independent of heat loss by radiation, convection, evaporation, conduction, etc., since the losses in the two cases are identical. The amount of power measured includes the losses.

Diathermy machines usually are equipped with a power control for varying the amount of power that is supplied to the patient. In an efficiency test the power tap

as well as the voltage tap used must be noted.

Test Results. The diathermy machine we utilized had three voltage connections and a power switch. An efficiency run was made for each of the voltages and for each setting of the power tap for these various voltages. The efficiency of the machine ranged from 2-3 to about 50 per cent. The test was conducted according to the scheme outlined in the preceding paragraphs. Several tests were made and the results were averaged. These averages are presented in graphical form in Fig. 1.



To interpret the graphs in Fig. 1, let us consider the high voltage section of tap 3. It is seen that the per cent efficiency is nearly fifty. This indicates that if we have the diathermy connected to a patient with the power control set at tap 3 and the electrodes connected to the high voltage terminals, half the power supplied to the machine will be delivered to the patient as heat. Looking at the double hatched section representing the efficiency of the low voltage connection with the power terminal set at 5, it is observed that the machine is only 2½ per cent efficient. In other words, if the machine is drawing 200 watts from the line, only 5 watts of that, ever reach the patient. The rest of the energy is wasted in the machine as iron losses, copper losses, and other stray losses. These losses manifest themselves as heat which affects the machine but not the patient.

Thus we have a portion of the answer to our question, why one machine may be better than another. Referring to Fig. 1, and assuming that 1, 2, 3, 4, and 5 repre-

sent different machines operating under the same conditions, it is apparent that machine 4 is superior to the others. If we compare it with No. 1 and assume that the machine was operated on the average of 3 hours a day throughout the year, and electricity costing 5 cents a kilowatt hour we would have a power saving of about \$55.00 by using machine 4 instead of 1.

Another factor to be considered which bears upon the efficiency of the machine is the size of the member treated or, in engineering terms, the resistance in the patient's circuit. Different patients and different resistances will cause considerable variation in the efficiency of a machine. It is well then to know what resistance we have considered as that of the patient at the time the efficiency is measured. To show this variation a test was conducted in which the resistance of the patient's circuit was changed and the efficiency determined for the various resistances.

Figure 2 shows the results of this test. The dotted curve shows how the efficiency varied with a change in resistance. This particular machine has a maximum efficiency in the region of average patient resistance. A machine which does not have its maximum efficiency in this range would be undesirable.

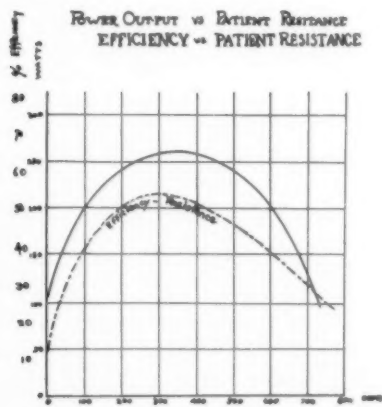


Fig. 2.

The solid line curve on the same plate indicates how the amount of power varies with the patient resistance.

Heat distribution. Generally speaking the distribution of heat will follow that of the current. The fact that the heat is proportional to the square of the current causes the distribution to be exaggerated. That is

to say, where the current is small the heat will be very small, and where the current is large the heat will be extreme. However, in the human body we see other factors which tend to offset this exaggeration. Circulation, conduction, etc., tend to smooth out this exaggerated distribution, so that the net result of the heat distribution is about the same as that of the current.

When the human body elevates its temperature the flow of heat is from the inside out. The heat produced by diathermy has essentially an outward flow, especially as compared to an electric blanket or cabinet in which the heat is forced from the outside in. Accepting the usual convention that heat flow in the *normal* direction produces a *positive heat gradient*, we may say that diathermy produces a *positive heat gradient* as contrasted with the blanket and cabinet which by the same convention produce a *negative heat gradient*.

Voltages. The study of the voltages in the patient circuit of a diathermy machine is of utmost importance in regards to sparking and burning at the electrodes. When the voltage gradient becomes higher than the dielectric strength, electrical breakdown takes place and a spark ensues. If the spark is fed with any appreciable amount of power an arc is formed. Furthermore after the initial breakdown has taken place, a very much lower voltage will maintain an arc than was possible at the beginning.

In speaking of the voltage of an alternating current we most always speak of the effective voltage. In fact it goes without saying that we are concerned with effective voltage, and anything else must be properly designated. The effective value is that which multiplied by the current gives power or heat. Most of the measuring instruments for the alternating current indicate effective values. In a pure sine wave the effective value is 70.7 per cent of the maximum or peak value. That is to say, the voltage starts from 0, rises to 1.414 times the effective value, drops to 0, and then starts in the negative direction to 1.414 the effective, back to 0 and so on. In non-sinusoidal waves and especially peaked waves such as are present in diathermy, it is frequently found that the voltage some

times builds up several fold the effective value.

This high voltage is maintained for only a small fraction of a second, but even if the voltage gradient at this point is in excess of the dielectric strength, breakdown is likely to occur. Once the breakdown has occurred the lower voltage will be able to prolong and arc, whereas they of themselves would have been unable to cause even a spark. Hence it is desirable to keep the peak voltage as low as possible and still have the effective high enough to secure sufficient heating.

Figure 3 shows the relationship of the effective voltage and peak voltage of the diathermy machine previously mentioned.

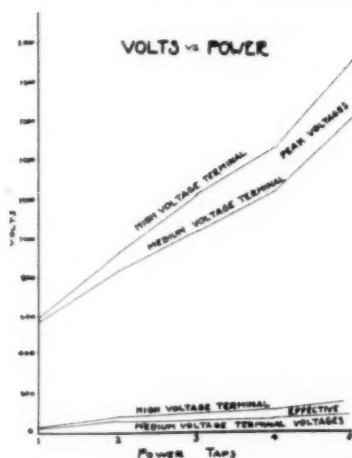


Fig. 3.

It is observed in Fig. 3 that while the effective voltages are only about a hundred volts, the peak volts rise, in the case of the high voltage, to nearly 2,000 volts. This will also help in comparing machines. The best machine would be one in which the peak voltage was only about half again as much as the effective and not 1200 per cent of it, as in the case of the machine tested. It is to be emphasized here that the higher the peak voltages rise the greater the likelihood of sparking.

Short Wave Machines

Efficiency. In a test of efficiency of a radiotherm or short wave machine much the same procedure was used as on a diathermy. The calorimeter is modified so as to admit a pair of insulated electrodes. A preliminary test on the empty calorimeter

should be made in order to determine the amount of heating caused by its exposure to the field. The thermometer is not inserted in the solution until after the high frequency has been shut off, for the field will considerably affect the thermometer.

Tests were conducted on two machines operating at their maximum power ratings. The patient circuit was put into a resonant condition and the voltage at maximum. Both machines were of about the same wavelength, one being 15 meters and the other 16 meters. The 15-meter machine gave an efficiency of 40 per cent and the 16-meter machine tested 11 per cent efficient. In general the higher the wavelength the more efficient will be the machine. A particular vacuum tube usually operates more efficiently as an oscillator at the higher wavelengths than it does at the ultrashort ones. The explanation of the above results is that the 15-meter machine was more carefully designed and used tubes that were better suited for the work.

Heat Distribution. In short wave therapy the heat gradient is positive as in the case of diathermy. However, the actual distribution of the heat throughout a body is vastly different from that of diathermy. The heat follows a plot of the field strength. The distribution of the high frequency field is determined essentially by three factors: 1. The location of the applicators and the orientation of the body between them. 2. The dielectric constant of the body or parts of the same. 3. The specific high frequency resistance.

The first two are the most important factors governing the distribution of the field. The dielectric constant may be thought of as that factor which expresses the ability of a substance to concentrate lines of electric force. Air can conveniently be taken as standard for rough comparison by arbitrarily setting its value at unity. Frequently the *dielectric constant* is called *specific inductive capacity* because of the manner in which it is determined. This is perhaps a better name, for especially at the high frequencies the *specific inductive capacity* is far from being a constant, but is a function of the frequency.

For most substances the specific inductive capacity is greater than unity (compared with air). The magnitude of some of the

more common substances is roughly shown in the following table:

Asphalt	2.6
Glass (Flint)	10.0
Sulphur	4.0
Wood	2 to 7
Glycerine	56.0
Castor Oil	4.5
Blood	75.0
Saliva	79.0

This specific inductive capacity and the specific high frequency resistance greatly influence the amount of heat that will be generated at any given frequency.*

A very important factor in the testing, or, as far as that goes, in the actual use of a machine, is the location and calibration of the ammeter in the circuit. The patient forms a part of a resonance circuit. In a resonance circuit the relationship of the current and voltage vary with the geometry of the circuit. In many machines that have been observed the ammeter that should indicate the dosage does not at all indicate the true amount of power that is being delivered to the patient. Too much stress cannot be placed upon the correct location and calibration of the meter. The length of the leads, size of the electrodes, size of the member being treated, shielding of the meter all will influence the amount of current the meter will indicate.

To illustrate this, a six meter experimental machine with long leads in the patient circuit was tested. Identical milliammeters were placed at three foot intervals in these leads. Meters in the *same lead* at the *same instant* gave readings that differed by as much as 200 per cent. This showed very markedly how the length of the lead and position of the meter influences the readings of the meters. The effect is particularly observable at the ultrashort wavelengths.

Electric Blanket

The blanket from which the test results presented here were taken, represents one of the more refined commercial designs. The distinctive feature is that the blanket operates at a low voltage and has a series-multiple connection of the resistance units. The resistance wires are connected in

groups of thirty multiple strands running the full length of the blanket. Up to nearly half of the resistance wires may be broken and the blanket will still continue to operate. This is of course a distinct advantage over the other type of blankets that employ a series connection, which would be inoperative when the strand breaks.

In the comparison of blankets it is well to determine the voltage that might be developed across the two ends of a broken strand. This voltage may be measured with a voltmeter connected to the ends of a broken strand. If the tension exceeds thirty volts there is danger of shock. Of course voltages of thirty volts and less can produce an unpleasant sensation, but there is very little danger from external shock from voltages below this value.

The question is often raised how sufficient heat can be produced from a blanket that operates on lower than thirty volts. It is to be remembered that power or the number of watts is equal to the product of the voltage and the current:

$$\text{Watts} = \text{Volts} \times \text{Amps.}$$

It is possible to secure a certain number of watts by having either the voltage high or the amperage high. For example, a blanket operating at 110 volts and drawing 6 amperes will produce 660 watts of heat; on the other hand, a blanket operating on only 5 volts but drawing 132 amperes will also produce 660 watts of heat. For operation on alternating current lines a small step-down transformer presents a very convenient way of securing a low voltage for a blanket.

The test blanket used a small transformer that stepped the line voltage down to 4.7 volts. This voltage is less than that used in the ordinary flashlight or door-bell. Three flashlight dry cells would give a higher voltage than is used on the blanket. Several strands at different places were broken and the voltage measured. The maximum across any broken strand was 1.09 volts. If the tongue is placed across the two ends of broken strand no shock is experienced; only the characteristic salty taste of a very low voltage is noticed. A blanket of this type is entirely free of any danger of electrical shock.

Efficiency. In the consideration of the efficiency of the blanket the transformer was

* This relationship is discussed in detail in *Physics of High Frequency Heating*, Archives of Phys. Therap., X-Ray and Rad., October, 1934.

first tested. The transformer was a portable one, encased in an aluminum shield. The total weight was about twenty pounds. Generally speaking the efficiency of a small portable transformer is not high. This transformer gave efficiencies of:—

<i>Power Tap</i>	<i>Efficiency</i>
High	91.1%
Medium	93.3%
Low	92.3%

Since the leads that connected the blanket with the transformer were heavy and short, there was very little loss in them and for all practical considerations the efficiency of the blanket as a whole may be considered as the efficiencies listed above. All the power delivered to the blanket is converted into heat, the efficiency within the blanket itself being 100 per cent.

The high current flowing through the parallel wires of the blanket gave some inductive effect, also the transformers inherent inductance caused a slight lag of the current behind the voltage. The total lag for the low power tap was found to be 15, and for the high tap was only 10 electrical degrees.

In comparing the blanket with a diathermy or radiotherm it would not be fair to compare just the transfer of electrical energy into heat energy. In the blanket much of the heat that is generated is not useful and does not transfer to the patient but goes to heating up the surroundings. In the high frequency machine practically all of the output does go into elevating the patient's temperature.

To determine quantitatively the portion of the heat generated that is transmitted to the patient is a very difficult task if any great degree of accuracy is desired. The method used in this test is reasonably accurate and does indicate the magnitude of the heat given off to the patient.

Rubber dummies were constructed to approximate the dimensions of a person. These dummies were filled with about 150 lbs. of water. The exact temperature and weight of water was recorded at the beginning of the test. The dummies were then wrapped in the blanket and the current turned on for a definite period. The temperature at the end of the run was meas-

ured, as from the elevation of temperature, weight of water, and duration of test the total amount of heat can be calculated. The total power input can be determined by a watt hour meter. The dummies empty weighed only a very small percentage of the total, since the specific heat of rubber is quite small, and the heat absorbed by the rubber can be neglected. The average of the tests showed that 30 per cent of the total heat will be absorbed by the patient.

In these particular tests two dummies were used, one of yellow and the other of dark gray rubber. Under exactly similar conditions it was found that the gray dummy absorbed 3 per cent more heat than the yellow. This difference no doubt indicates that there is considerable radiant heat and infrared generated in the blanket. This variation can be accounted for the different absorption coefficient of the two colors.

Blankets similar to the one tested have been used clinically by numerous physicians during the past two years. They have demonstrated their efficacy where pyrexia and hyperpyrexia are indicated.

Clinical tests have shown that temperatures could be raised from 1 to 5 degrees in from 45 to 75 minutes. Perspiration begins within 15 minutes after the start of the treatment and continues to the entire time of treatment both during rising and falling temperature.

Many successful 2 to 3 hour treatments have been given without any outward symptoms. As in other conductive methods a sedative of morphin sulfate of one-quarter grain is administered hypodermically 45 minutes after the start of the treatment, and chloride replacement therapy to compensate for the excessive perspiration is always used. The results of the treatments indicate that the restlessness and aching pains in the limbs which usually occur in any form of hyperpyrexia treatment is caused by loss of chloride.

As some conditions indicate a 6 to 8 hour treatment, no difficulty is anticipated even in these long treatments if the above technique is followed. The blanket provides a simple, safe and effective way of raising temperature and maintaining it.

Conclusion

The results of tests show that diathermy machines can be compared on the basis of

efficiency. Other factors being equal, the machine with the highest efficiency will be worth more to the physician by the amount of saving in his power bill. The second important point in regard to the diathermy machine is in the voltages developed in the patient circuit. The machine that has the lowest ratio of effective to peak voltages would be the most desirable and least likely to cause sparking and burns.

The problem of efficiency in the radiotherm or short wave machine is of more importance than in diathermy. A more efficient machine not only will mean a saving of light bill, but will mean a substantial reduction of maintenance cost and of tube replacement. Vacuum tubes last a great deal longer in oscillators with efficient circuits.

The difference in efficiency between any two brands of blankets will not in general be so pronounced as in the above mentioned machines. The more important feature to consider is the voltage and possibility of shocks and burns. We may conclude from this test that a low voltage blanket will prevent the danger of shock and burn and still be able to provide sufficient power. Further we may conclude that a multiple strand connection is to be preferred to a series connected blanket. In the final analysis the physician should so choose his apparatus that he will be able to develop his technic to the highest possible perfection.

Acknowledgment is made to John Peirce of California Institute of Technology for his assistance and suggestions in conducting the tests, and to the manufacturers for the loan of their apparatus.

Most Penetrating Artificial Gamma Rays From Sodium — Expect Great Use- fulness in Cancer and Medical Research

Discovery of a way to make the common element sodium give out the world's most penetrating gamma rays by artificial means was announced at the University of California and reported by *Science News Letter*. The radiation, it is believed, will have great usefulness in medicine for the treatment of diseases like cancer and in a study of how radiation acts on living tissue.

Sodium is one of the constituents of familiar table salt and occurs in certain of the fluids of the human body. Saline solution, for example, can be injected into the blood stream of the human body without disastrous effects.

The new gamma radiation produced in Prof. Lawrence's laboratory from sodium is more penetrating than any ever before obtained. Sodium gamma rays have energies of 5,500,000 electron volts. Most penetrating of the naturally produced gamma rays are those of thorium C" (thorium C double prime) having energies corresponding to only 2,600,000 volts.

Most powerful and penetrating of the hitherto man-made gamma rays are those created by Drs. C. C. Lauritsen and H. R. Crane of California Institute of Technology from carbon. The carbon gamma rays had energies of 3,500,000 volts. Prof. Lawrence's radiation, therefore, exceeds the previous records for gamma rays produced both naturally and artificially.

More important still, from the standpoint of possible medical use as in cancer therapy, the radio-sodium gives out its rays for a long time. The half life of the substance is 15 hours, that is, the original amount disintegrates to half in this time. Most of the elements with which artificial radioactivity has been produced do not last nearly as long. Two hours has been a long time hitherto; a few minutes of activity was the general rule.

Prof. Lawrence creates his artificially radioactive sodium by bombarding sodium with deuterons, the charged nuclei of the new, heavy hydrogen. These deuterons are shot at the sodium with energies of 1,750,000 electron volts.

Besides the very penetrating gamma rays, beta rays or electrons come off from the radio-sodium. This happening indicates, Prof. Lawrence suggests, that the radioactive substance is a form of sodium which disintegrates into magnesium. Chemical tests confirmed this suspicion, he declares.

The way gamma rays from sodium are absorbed in lead suggest the radiation emitted is probably all of one wavelength, or monochromatic. This finding will make the new radiation extremely useful in physical experiments.

"It perhaps should be mentioned," declares Prof. Lawrence, "that many uses of radio-sodium will probably be found. In the physical laboratory it provides a presumably monochromatic source of high energy gamma-radiation of great intensity. In the biological field radio-sodium has interesting possibilities that hardly need be emphasized here."

ARCHIVES of PHYSICAL THERAPY, X-RAY, RADIUM

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EDITORIALS

CANCER OF THE NASAL SINUSES

In spite of the fact that in recent years rhinologists have become cancer minded, and have lent every effort toward early recognition and treatment of malignant neoplasms of the accessory sinuses, numerous problems of this scourge still present themselves. These problems are not restricted merely in regard to therapy but to diagnostics as well. The tendency to regard cancer of the sinuses as "primary" growths should be corrected. Only recently, Nash⁽¹⁾ in his conclusions on the management of malignant neoplasms of the sinuses stated: "Primary neoplasms of the sinuses are usually seen late because the symptoms appear late." That primary sinus cancer is rarely if ever encountered is pointed out by Lederer⁽²⁾ elsewhere in this issue, his main object being directed to rationalize therapeutic attack. Lederer's arguments are sound and convincing, showing that our attention to this phase of the location of the pathologic process is frequently diverted. Were it otherwise, we would not consider a new growth in a certain area as *primary* after every normal landmark has been obliterated. It is difficult to understand why rhinologists have not stressed this fact, because it is undebatable in the light of our present knowledge of pathology.

Interesting, too, is the problem of differential diagnosis. There is little doubt that patients with malignant disease present them-

selves at an advanced stage, nor that we frequently underestimate the initial symptoms which are virtually identical with those of simple inflammatory processes. Not until nasal obstruction becomes pronounced and mechanical displacement of the parts ensues, do we often recognize the true pathological picture. Biopsy, of course, renders the diagnosis conclusive. As regards therapy, a delayed attack renders conservation of normal anatomical structure impossible, radical procedures only affording the patient a prospect of a curative result.

Many are still treating cancer of the sinuses as we did a few decades ago. With the exception of electrosurgery, there has been no striking advance in our therapeutic facilities. And while this agent is strictly a local weapon, it has superseded the scalpel because of the very definite advantages it affords the surgeon in extirpation, excision, or reduction of a growth. Like other procedures, electrosurgery in itself is frequently therapeutically inadequate, requiring the reinforcement by postoperative x-ray and radium applications. Of irradiation, the same can be said as of electrosurgery, experience having demonstrated that in the large majority of cases, even a combination of procedures leaves much to be desired in end-results. Nevertheless it must be conceded that a combination of radical electrosurgery with postoperative irradiation has already been pro-

ductive of much good. Still better results may be looked forward to partly by securing the early cooperation of patients, general practitioners and otolaryngologists, and partly by the judicious application of the available resources, singly or in combination, provided they are employed on a scientific basis. Routine therapy must be abolished and individualistic management accorded the sufferers from the standpoint of the characteristics of the malignant lesions and their constitutional involvement.

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LEGISLATION INIMICAL TO PHYSICIANS

The Journal of the American Medical Association in its issue of March 9, 1935, brings in its news columns the information that a bill has been introduced in the lower house of the State of Georgia proposing to create a board of Physiotherapy Examiners and to regulate the practice of Physiotherapy. This bill, H. 275, defines and proposes to limit the practice of physiotherapy as follows:

'The diagnosis and treatment of human ailments by the use of any natural force or agency, the basis of which is water, heat, sunlight, electricity or electrically produced energies, mechanical appliances, ultraviolet light, infrared light, manipulations, corrective exercises, dietetics, massage, external applications and mineral baths.' The bill proposes to prohibit anybody but a licentiate of the board from practicing physiotherapy as defined but exempts (a) persons authorized by the law to practice medicine and surgery and (b) persons who at the time of the enactment of the bill are members of the Georgia State Association of Physical Therapy or who have been engaged in the practice of physiotherapy at least one year prior to the enactment of the bill. An applicant for a license must be a high school graduate or have an equivalent education, must have studied physiotherapy for two years in a school of physiotherapy approved by the board, and must pass a satisfactory examination in history, anatomy, physiology, chemistry, pathology, diagnosis and treatment, bacteriology, massage, therapeutics, clinical physiotherapy and such added subjects as shall subsequently be taught by accredited schools of physiotherapy.

It is evident that another vicious attempt is being made to enter the practice of medicine through the door of political influence. It is not enough that in the past numerous

individuals desirous of gaining an easy livelihood from treating the sick without first undergoing the rigid training of medical students have found ready revenues in the haven of our specialty, but now a new profession is threatening to compete with scientific organized medicine under a state charter. It is high time that the medical profession inform the various legislators that while they have the power to grant privileges to professions, this power cannot be abused to rubber stamp unqualified persons into members of a learned profession. They should be further informed that such indiscriminate use of legislation is subservient to the best interests of the community at large as well as to the economic interests of a part of its citizenry who devote their lives to the welfare of communities and to the scientific care of the sick. It may be held by the sponsors of this bill that the concerned individuals are really not competing with legitimate medicine in that they will administer neither medicines nor perform surgical operations. This argument falls flat since the bill, as worded opens wide the field of diagnosis and independent therapy to persons who cannot possibly qualify for such responsibility without the years of training imposed on licensure to practice medicine.

The American Congress of Physical Therapy has recognized the value of the services rendered by physical therapy technicians and has undertaken the task of registering and organizing them as an honorable profession with the distinct understanding that their work must be directed and controlled by medical men who alone are in a position to determine the indications and methods of application of physical remedial measures. It is hoped therefore, that the medical profession not only in Georgia but throughout the United States will not be caught napping but enter a decisive protest against the lowering of standards of the practice of medicine and against the arbitrary and vicious creation of legalized pseudo-medical crafts.

SPRING SESSION OF THE EASTERN SECTION OF THE AMERICAN CONGRESS OF PHYSICAL THERAPY

The 1935 spring session of the Eastern Section of the American Congress of Physical Therapy opened during the evening of Friday, March 29, jointly with the Baltimore County Medical Society. The program was so inter-

esting to both the members of the Congress and their hosts, who took an active part, that the addresses and their discussions were not brought to a conclusion until after midnight.

The following morning the session was opened promptly at nine in Johns Hopkins Hospital. After an address of welcome by Dr. W. T. Loncope, which was as stimulating as it was warm in sentiment for the cause of physical therapy, the convention plunged into work, including a thorough inspection of the physical therapy department of the hospital. The visitors freely expressed their admiration for the suitable location and up-to-date equipment of this department of the famous hospital.

After an enjoyable luncheon served in the Phipps' Psychiatric Building, the convention resumed its work in the University of Maryland, where the members first listened to an address of welcome by Dr. A. J. Lomas. The address was of a nature which Frenchmen would describe as "cent milles bienvenues" one hundred thousand welcomes.

The papers were of a very high order and as they will no doubt find their way in the columns of the ARCHIVES it must suffice here if your reporter merely states the fact that the large audience manifested a profound interest. This was shown not only by the very critical discussions but by a number of questions that were asked from the auditorium and answered by the different speakers.

At the close of the session Dr. Lomas escorted the members and visitors through the hospital which is a model for efficient service. This was followed by a visit to the Children's Hospital, where an opportunity was accorded us to observe the advances made in rehabilitation. It soon became evident that the successes there attained were ascribable to the earnest efforts of the physicians and the loyal and intelligent cooperation by their technicians.

At the evening banquet which was held in the Hotel Belvedere, Dr. Hugh Young, of Johns Hopkins Hospital, delivered a memorable address. But the human side of our calling was brought into strong relief by the presentation of "reminiscences" by that famous surgeon and pioneer in our field — Howard A. Kelly.

Three hundred thirty-five physicians attended this session, and one can state without ex-

aggeration that physical therapy has made numerous friends not only in the rank and file but among the luminaries of our profession, not a few of whom came to realize the importance of our specialty in general medicine and surgery. There is no doubt that in this section of our country physical therapy has gained new adherents who have benefited from the session to the extent of seriously interesting themselves in the fundamentals and clinical application of physical therapeutic measures.

MADGE C. L. MCGUINNESS, M.D.,
New York.

INSPECTION OF SCHOOLS FOR TECHNICIANS

It is with satisfaction that we call attention to the increasing interest of the American Medical Association in the training of physical therapy and other technicians. The American Congress of Physical Therapy is indebted to the Council on Medical Education and Hospitals of that national body for its recent investigation of schools for men and women desirous to qualify as occupational therapy, laboratory, and physical therapy technicians. What the Council has accomplished so far is shown in its report published in the March 30, 1935 issue of the *Journal of the American Medical Association*, an excerpt of which follows:

Schools of Occupational Therapy.—The inspection of these schools, which began Nov. 27, 1933, was carried out in conjunction with the other activities of the Council, the schools being inspected by members of the staff on their regular tours among hospitals. Up to the present time, twelve schools have been visited.

Inspection included a study of the organization, faculty, physical plant, resources, administration, publicity, and a detailed study of the curriculum.

Essentials of an acceptable school of occupational therapy are being set up in cooperation with officials of the American Occupational Therapy Association. When these essentials are finally approved by the House of Delegates, a list of acceptable schools will be prepared.

Schools for Physical Therapy Technicians.—The Council on Physical Therapy and the Council on Medical Education and Hospitals of the American Medical Association have been lending their cooperation to the Congress on Physical Therapy in the formulation of proper standards for the Registry of Physical Therapy Technicians.

The Board of Trustees of the American Medical Association in 1934 was directed to effect, if feasible, some plan for rating schools for physical therapy technicians. The Trustees passed the matter on to

the Council on Medical Education and Hospitals.

The Council has inspected thirty out of the forty-three existing schools. On the completion of this survey, the Council together with the representatives of the American Physiotherapy Association, the Congress on Physical Therapy and the Council on Physical Therapy will formulate proper educational requirements and essentials for approved schools of physical therapy. When these essentials are approved by the House of Delegates of the American Medical Association, a list of approved schools for physical therapy technicians will be prepared.

From the above statement it is evident that we may confidently look forward to an early standardization of the training of all classes of technicians. This will put an end to mushroom schools run for profit rather than for adequate training and assure a personnel on whom physicians may rely. As the report indicates the registration of physical therapy technicians will rest mainly with the American Congress of Physical Therapy, and it hardly needs assurance that it will be carried out to the best interests of all concerned.

PROGRAM FOR THE FOURTEENTH ANNUAL SESSION NOW BEING PREPARED

With the spring sessions concluded, plans are going ahead at top speed for the annual gathering in Kansas City. The Convention Committee is compiling the program which will be along the lines of that of last year. Sectional meetings will be held only for group conferences, while the main program for the presentation of addresses and papers will be conducted in joint session.

An invitation is extended to members of the Congress to participate in the program, but certain rules have been formulated by the Board of Governors which will govern such participation. These are, in part:

1. No member who has appeared on the main annual program one year shall be permitted to appear the following year. In other words at least two years must elapse between each participation. This does not apply to group conferences, scientific exhibits or gatherings other than the main program.

2. A member who accepts assignment for participation in the program forfeits his rights to publication of his paper in the official journal unless such paper has been presented in person.

It has been necessary to adopt these rules because of the limited number of places available with the omission of the sectional meetings. It appears that the general plan of last year's program was more acceptable than that of previous years and for this reason it will be adhered to again.

It should be added that there is an ample number of places in the group conferences where members who have specialty subjects to present are invited to do so. Reservation of places should not, however, be deferred until a late period. The preliminary program will be issued just prior to the summer vacation, making it quite necessary that all assignments be confirmed at the earliest possible time. The cooperation of the membership is urgently solicited by the Convention committee.

It is the aim of the committee to present as complete and attractive a program as can be arranged. There is every reason to believe that those who contemplate attending the fall session will not be disappointed.

SCIENTIFIC EXHIBITS — 14TH ANNUAL SESSION AT KANSAS CITY, MISSOURI

The success of the scientific exhibits at last year's session in Philadelphia has greatly encouraged the convention committee to solicit a similar display for the 14th annual session which will be held in Kansas City, Missouri, September 9, 10, 11, 12. Adequate space will be furnished without cost to individuals and to institutions for exhibition of scientific material pertaining to physical therapy and its allied fields.

Members of the Congress in particular are urged to plan exhibits on special subjects in which they are interested. Members are urged also to solicit others who might have suitable material for display.

The Congress is extremely anxious to have teaching institutions, hospitals and research organizations represented, but this in no way should discourage individuals from taking part.

Suitable prizes in the form of medals and certificates will be awarded.

Those contemplating representation in this year's scientific exhibit should correspond immediately with the executive secretary of the Congress, Marion G. Smith, 30 North Michigan, Avenue, Chicago.

D'ARSONVAL AND CLAUDE BERNARD

DISRAELI KOBAK, M.D., AND GUSTAVUS M. BLECH, M.D.

CHICAGO

It is remarkable that in these days of economic distress, of unfair competition, and of attacks on the medical body politic by misguided fanatics and worse, at least one medical organization has preserved a spirit of idealism which made possible an enterprise of homage to a great savant — Claude Bernard.

On January 6, 1935, there took place in the city of Paris a medical event of general interest to our profession and of special interest to those stressing physical therapeutic measures. To appreciate the details about to be reported, it is necessary to become acquainted with a French medical organization which is as unique in its composition as it is in its objectives. It appears that a comparatively young physician of Paris, Dr. Henri Godlewski, conceived the idea that moot clinical questions could perhaps be best settled by actual experience which took into consideration some of the most important but variable factors surrounding the life of patients; i. e., the region of domicile, habits, climate, topography, food intake, and the like. An enthusiast in his profession, ever anxious to preserve its prestige through scientific advancement and greater therapeutic usefulness, an organizer of unusual ability and influence, Henri Godlewsky has today the gratification of being secretary-general and *rector spiritus* of a "national, medical tribunal," a society composed of all classes of membership. The rural practitioner thrown on his own resources under primitive conditions of life, the urban physician practicing his calling with the resources afforded by hospitals and laboratories, and the most renowned teachers of medicine equipped with the best attainable means to further research have membership on an equal footing. The national organization is divided into regional groups. During the past three years these groups have been called upon to collect clinical data on such moot problems as alcoholism, cancer, diphtheria, goitre, tetanus, tuberculosis, and the like. These are not only collated but critically analyzed and evaluated with the aim of arriving at definite conclusions. The observations of the humblest

country doctors are weighed with the same care as the statement of the most renowned specialist, differences in experience being examined from the standpoint of variations of life and habits of the widely separated peoples.

Several times a year (sometimes six) the national body meets in solemn conclave to bring to a definite solution problems scheduled a year in advance. And it so happened that while the 14th session occupied itself during the forenoon of Sunday, January 6, 1935, with the problem of the sufferers of hypertension, the afternoon was dedicated to a move to create a reliquary "Claude Bernard." This must be accepted in the literal sense, for the purpose is to preserve for posterity the unpublished notes and manuscripts, the instruments and appliances, even the very furniture used in the research by the man whose name the medical shrine is to bear.

To us this event is the more remarkable because the large assembly centered around the dignified and yet so human figure of — Arsène d'Arsonval. And human much more than scientific is the interest that was roused by a scene as simple as it was touching, as dignified as it was democratic. Addresses were delivered by several noted physicians, among whom the venerable Dean of the medical faculty of Paris, Henri Roger, stood out in greater relief as he discoursed on the contributions to medical science by the man who is justly regarded as the father of experimental physiology.

Then came a solemn moment. A living savant with gentle but penetrating voice was heard addressing in the magic tones of retrospection not an audience of confrères as much as an individual, a comrade, a friend, whose spiritual aura appeared to permeate the deepest recesses of this conclave. It was a eulogy vibrant with memories, warm and sincere. It was the living savant, perhaps the greatest authority on electrophysiology and the father of modern physical therapy, Arsène d'Arsonval, upsetting traditions and relating the unknown facts of the influence on his life by Claude Bernard, an influence which in part

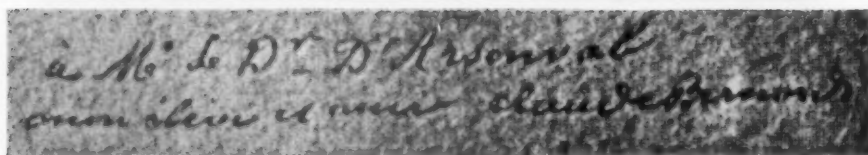


Fig. 1. — One of the latest photographs of Claude Bernard presented to Professor d'Arsonval by the great savant.

explains the background and direction of d'Arsonval's research in the field of electrophysiology. And as this is of especial interest to us who make medical and surgical use of d'Arsonval's discoveries, we outline his address on the memorable occasion, parts of which are virtually in his own words.

Claude Bernard, the orator opened, has been described as a scientist, but the moment has arrived to comply with the wishes of the assembly and talk of him as a man. The oppor-

tunity is propitious, for were he present in the flesh, no homage that has been accorded him would have touched him as deeply as that by the general medical profession of France. For the assembly is not only one of clinical "aces," but of plain country doctors who had aroused Bernard's especial interest. How often had d'Arsonval heard him say that it is the country doctors who see only facts and are not hypnotized by theories or systems.



Fig. 2. — Professor d'Arsonval at the very spot where he had assisted Claude Bernard, reading his reminiscences of his predecessor. The persons in the group from left to right are: Dr. Henri Godlewski, Prof. d'Arsonval, Dean of the Medical Faculty Roger, Prof. André Mayer.

That alone justifies the tribute by a body he would have been delighted to direct.

So far as the personal relation between himself and the deceased master is concerned, d'Arsonval remarked that his friend Bédier, the administrator of the Collège de France, at the former's jubilee had made a statement which the speaker would never have dared to believe. The fact is that after the incident of the broken galvanometer following an unforgettable lecture by Bernard, the teacher invited the young student to his home where at a simple table in his study he asked young d'Arsonval with paternal solicitude about his antecedents, his hopes and his aspirations. Set at ease by such benevolent simplicity on the part of a teacher who was then at the zenith of his glory, young d'Arsonval "let loose" without regard to time or conventions. He told his teacher that he was the son and grandson of country doctors, and that he, too, anticipated following in his father's footsteps. Claude Bernard thereupon remarked that it

was due to such paternal influence that young d'Arsonval could demonstrate the gift of observation, such as he had shown in the classroom. Suffused by praise from such a high authority, d'Arsonval involuntarily remarked that his grandfather had been an intimate of Baron Beyer and of Dupuytren and that his father had been a volunteer preparator of Laennec, who had occupied the very chair held by his host. That evidently was the key to Claude Bernard's esteem and affection, for when the young student was finally allowed to go, he was invited to assist in the experimental laboratory, which, Claude Bernard added, would not interfere with d'Arsonval's preparation for his doctorate examination.

Hours had been spent in that first memorable visit on December 6, 1873. Now d'Arsonval tells us for the first time something characteristic of Bernard's views of practical medicine which betray the interest of the father of experimental physiology and allied sciences in simple country doctors. Indeed,

this is of especial interest, for the great experimental work undertaken by Claude Bernard had, as is known, a tremendous influence on the advancement of scientific therapy. Young d'Arsonval was, of course, in a position to give a good description of his father's work in Limousin to gratify his teacher's interest. It is a story of a conscientious physician traveling on horseback over ill-defined mountain roads to visit the sick in widely separated hamlets, carrying drugs of proved therapeutic value in the saddle bags. The narrative is not devoid of humor. Pharmacies were few and far between. Precisely on an occasion when a special prescription had to be gotten filled by a distant pharmacist for a sick peasant woman, there were no writing materials. But there was a white painted door, and some pieces of burned wood, and so d'Arsonval's sire wrote the well thought out prescription — an art about to become lost — with charcoal on the door, had the peasant drive it to the pharmacy and secure the medicine for his sick wife. To all this his host had listened with profound interest.

The orator sketched the events that followed in a manner familiar to those of our readers who have read the special d'Arsonval issue of the ARCHIVES*. Briefly stated, young d'Arsonval did work as a volunteer in Bernard's laboratory for a few months when he was taken on as a regular preparator. In 1876, about two and a half years after the first meeting between Bernard and young d'Arsonval, the master wrote to the elder d'Arsonval pleading with the father to allow his son to remain in the laboratory to begin a career of research. This, of course, proved the turning point for him who today stands out to be as great a scientist in biophysics as his teacher, friend, and predecessor in the faculty of the Collège de France was in experimental physiology. Claude Bernard died about two years later, and while he had had during the last three years of his life the assistance of several capable men, they were occupied with their own teaching duties. As a result d'Arsonval really was the only one who aided him in his experiments, work which could not fail to develop those faculties which are essential to original research. But apart from the purely technical or, if you will, scientific aspect of d'Arsonval's association with

Claude Bernard, there was the influence of the cultured, thinking man interested in philosophy, in literature and in the arts, which the orator stressed as having culminated in much good.

The historians who have written about Claude Bernard have left a number of gaps and some inaccuracies. After Bernard's death and burial d'Arsonval made it his filially-pious duty to collect all possible data about the life and activities of his great friend. He has been successful in this, for in his search for such information which had to be gathered from reliable intimates before d'Arsonval came upon the scene, he had been fortunate. As to know Claude Bernard as a man means to understand the man d'Arsonval as well as the scientist, we present data documented in the address. Beginning as a young pharmacy apprentice Bernard turned even an accident to good account, at least it revealed his inclination towards experimentation. He was interested for a long time in the problem of manufacturing an automatic, or as we call it today, a fountain pen. Fortunately for science he essayed a literary piece of work, submitted it to a prominent writer, and followed the latter's advice to abandon any idea of a literary career no matter how talented he may be, and matriculate either in pharmacy or medicine. Young Bernard took the advice. At one time tempted to go to his native city to practice as a rural doctor, he was persuaded or rather coerced by friends to remain in Paris. His career is too well known to need further allusion here, so that we may restrict ourselves to that period during which d'Arsonval was associated with him. Two great problems agitated Bernard. One may be dismissed as of little interest to us because they dealt with courses on physiology at the Museum. The other, which immediately concerned d'Arsonval, was an experimental check on his older labors. This "critique," he told his young preparator, was not to antagonize any one, no matter who, but to establish the physico-chemical or mechanical conditions of the various phenomena he had observed, to fix them, as it were, in the sense of a rigorous determinism.

His last mental preoccupation pertained to the nature of alcoholic fermentation. He had studied the problem in his native village during the vintage of 1877. When he returned from his home town in October he brought

* 13, December, 1932.

with him a number of bottles smelling of musty raisin. D'Arsonval was directed to search for alcohol and ferments, for he was convinced that he had in the bottles a soluble alcoholic ferment. For two months the two men worked in the very small laboratory which now is to become the "Claude Bernard Reliquary." Imposing silence until he would succeed in isolating the ferment, Bernard became bed-ridden and d'Arsonval continued in the experimental work without attaining any positive result. Bernard advised him to experiment with the yeast of beer by adding small quantities of a solution of uranium nitrate, which was a slow poison affecting nutrition and arresting development. This notation was found by d'Arsonval after Bernard's death in notes left by the savant. And, as d'Arsonval says: This incomparable observer had therefore already discovered the abiotic characteristics of radioactive substances. The incident of the posthumous publication of a manuscript which was interpreted as antagonistic to the

findings of Pasteur's work along similar lines, d'Arsonval explains that he was greatly touched when Pasteur told him of his chagrin at having been kept in ignorance by his closest friend in the Academy. Pasteur's side is given in an easily accessible book,* and here it must suffice to state that d'Arsonval had calmed Pasteur by the proof that Bernard had pronounced the former's experiments as unassailable. Whatever differences these two great men had were indeed purely technical in nature, for while Pasteur saw or rather envisaged microbial causes of phenomena, Bernard saw the terrain (ground). Finally d'Arsonval concluded his address with a citation, the spirit of which we have reason to believe served him as a guiding star in his epochal endeavors to date. In essence the thought centers in physiologic research based on facts and not on intuitive theories.

* The Life of Pasteur. By René Valléry-Radot. Translated from the French by Mrs. R. L. Devonshire. Garden City, New York, Doubleday, Page & Company, 1923.

THE STUDENT'S LIBRARY

GRUNDRISSE DER KURZWELLENTHERAPIE. Physics — Technics — Indications. Einführung in die physikalische-Technischen und Medizinischen Grundlagen der Anwendung Kurzer Elektrischer Wellen für Ärzte und Biologen (Fundamentals of Shortwave Therapy). By *Dr. Ing. Wolfgang Holzer*, Assistant at the Physiologic Institute of the University of Vienna, and *Dr. Med. Eugen Weissenberg*, Director of the Short Wave Department of the University Clinic of Vienna. Cloth. Pp. 186 with 53 illustrations. Price, 8 marks. Vienna: Wilhelm Maudrich, 1935.

At this moment when organized medicine in America is regarding with timorous emotions the unprecedented growth of shortwave therapy — its own neglected offspring — and cautioning the profession toward greater conservatism until more is known of its physical, physiologic and clinical properties, contributions in this field have become so voluminous and impressive in their scientific import as to result in the publication of several scholarly volumes. The foregoing book is an example of the creative efforts, scientific vision and the splendid industry that has been especially subscribed by our foreign colleagues. The information collated in these pages is an answer to the many queries now propounded regarding the physical principles and biologic properties in relation to short wave therapy, as well as

to its indications, contraindications, dangers and practical applications. Emanating from such a conservative environment as the physiologic institute of the University of Vienna and from one of its clinics, the rigorous style of evaluating the listed data is in keeping with the highest ideals of scientific exposition. Its objective has been to present all available facts with mathematical precision.

The volume is divided into two sections: technical and clinical. The technical discussions have been written by an engineer on the faculty of the physiologic institute. While sufficiently clear in his exposition Holzer has often found it necessary to introduce the mathematical formula to clarify some of the moot problems regarding the physics of short wave radiation — an annoyance to those not conversant with the precision of mathematical language, but on the other hand, welcome guidance to those otherwise informed. One finds here the answer to the question as to the nature of short wave radiation, its action and method of transmission. It explains the actual difference between diathermy and condenser field phenomena, the action of short Hertzian waves upon biologic and phantom experiments, its extent of penetration, selective, specific and polarization effects. This section will undoubtedly be found to be a veritable treasure house of information for such readers as are in search of physical

principles regarding construction, measurement, and biophysical action of short waves. Chapters 2 and 3 are particularly recommended to those who are in search of the answer to how to measure the energy and study the great advances already made in the construction of short wave apparatus abroad.

The clinical part of this work presents a rather loosely knit discussion of many pathologic conditions. As compared with the detail of the preceding section, here an attempt has been made to summarize the clinical action of short wave radiation in broad strokes. Such a plan has the advantage of offering the reader a wider horizon of the work already accomplished. The authors have reviewed over 244 selected articles in this special field of therapy, and it is interesting to note that not only have they confirmed the majority of other men's findings, but have added to our orientation in regard to its particular action in the field of neuropsychiatry. Emphasizing its special value in pyogenic infections, monarticular arthritis, vasospastic diseases, and acute inflammatory states, they have pointed out its limitations in acute polyarticular rheumatic states (preferring "pyrothermie"), and in acute neuralgias and neuritides. Nevertheless, they have personally found short wave therapy of value in such scattered affections as multiple sclerosis, sciatica, polyneuritis (toxic), trigeminal neuralgia, brachialgia, occipital neuralgia, intercostal neuralgia and herpes zoster, epilepsy, general paralysis, and the like.

This conservative evaluation of short wave therapy, which includes reports of many cases, and an analytical review of the work from selected authorities, is an impressive contribution and will go a long way toward encouraging new disciples in its wider use. This book has an important message for the English medical reading public and hence its early translation is actively suggested.

HUMAN STERILITY. Causation, Diagnosis and Treatment. A Practical Manual of Clinical Procedure. By *Samuel Raynor Meaker*, M.D., Professor of Gynecology, Boston University School of Medicine; Gynecologist, Massachusetts General Hospital, Chairman of Subcommittee on Sterility, National Committee on Maternal Health, Inc. Cloth. Pp. 269, with 27 original illustrations. Price, \$4.00. Baltimore: The Williams & Wilkins Company, 1934.

Professor Meaker has presented to the medical profession an outstanding work on the subject of sterility. Although presented by a gynecologist the sterility problem is discussed as one of both sexes rather than that of a disorder in the female. A big forward stride will have been made when the profession will also come to regard sterility as a combined problem of two individuals — the husband and wife. During the past 20 years some real progress has been made in treating sterility, and probably the greatest impetus was given by the added use of gas patency tests and lipiodal visualization of the pelvic organs, and the newer studies on the sperms. Following a preliminary chapter on definitions and a discussion of incidence of sterility the book is divided into three parts. The first part is devoted to a consideration of causation of ster-

ility. The causes of sterility in the male and female are considered briefly but in sufficient detail. Part two deals with the diagnostic study of the sterile mating. Here the author includes methods of studying the male and female by urologic and gynecologic principles. Patency studies of the tubes and roentgenologic visualization of the pelvis are thoroughly discussed. Endocrinology and the part the internally secreting glands play in reducing the fertility are a feature of this book. Metabolic and constitutional studies are well presented. Part three is devoted to the treatment of sterility. Dr. Meaker's plan of study of the sterile couple is very thorough and he presents a schematic outline for investigative procedure that leaves nothing undone for determining the underlying background of the infertility. He is joined by a urologist for the investigation of the husband, an endocrinologist for metabolic studies, and an internist for a general physical examination. The author gives reproductions of outlines of the histories he uses. An interesting tabulation is made of 100 couples, studies made according to the principles laid down in the text. It is interesting to note that in most cases many factors, which if individually considered, may have been insignificant, but when combined tend to reduce the fertility of the patient. Often both female and male present combined multiple factors that render them sterile as a mating unit. This is without doubt an excellent manual that brings all data on the sterility problem up to date.

POLIOMYELITIS. A Handbook for Physicians and Medical Students. By *John F. Landon*, M.D. Attending Physician, Willard Parker Hospital; Special Consultant in Pediatrics, Woman's Hospital; Assistant Attending Pediatrician, Roosevelt Hospital, New York; and *Lawrence W. Smith*, M.D., Pathologist, Willard Parker Hospital; Formerly Associate Professor of Pathology, Cornell Medical College; Formerly Assistant Professor of Pathology, Harvard Medical School. With a section by *Garry De N. Hough, Jr.*, M.D., F.A.C.S., F.A.A.O.S., Attending Orthopedic Surgeon, Shriners' Hospital for Crippled Children, Springfield, Mass. Cloth. Pp. 295. Price, \$3.00. New York: The Macmillan Company, 1934.

This work is based on the authors' studies of the 1931 poliomyelitis epidemic in New York City. There were 1,000 cases admitted to the Willard Parker Hospital, from which material 81 autopsies were performed. This permitted excellent opportunity to study the etiology, pathology, epidemiology, symptomatology, the paralysis, laboratory aids in diagnosis, the differential diagnosis prognosis, prophylaxis and the treatment of the acute stage. As a criterion for their importance, it is pointed out that 211 pages are devoted to the exposition of the above mentioned topics, these providing valuable exposition of the modern concept of poliomyelitis. Their evaluation of the respirator will be a surprise to most physical therapists. They believe the respirator is capable of doing some harm as indicated by their clinical and pathological studies, which strongly suggest that the respirator perhaps by overventilation of the lungs with a resulting em-

physema, may predispose the pulmonary apparatus to subsequent infection or collapse.

Only thirty pages are devoted to the after care of the patient. This is the section written by Dr. Hough, and it is evident that unusual abbreviation has been exercised at the expense of important detail and to the loss of the general practitioner who wishes to obtain a complete knowledge of the treatment of this disease.

PERIODIC FERTILITY AND STERILITY IN WOMAN. A Natural Method of Birth Control. By Professor *Herman Knaus* of the German University of Prague. Authorized English Translation by *D. H. Kitchin*, Barrister-at-Law, and *Kathleen Kitchin*, M.Sc., M.B., B.S., London. Cloth. Pp. 162, with 64 illustrations and 12 tables. Price, \$6.00. Vienna: Wilhelm Maudrich, 1934.

This is a translation of the original German work which was reviewed in the September, 1934, issue of the *ARCHIVES*. The availability of the book in the English language in this country is to be welcomed in view of the importance of the careful and scientific presentation of the problem of ethical and natural birth control by the distinguished author. For the edition in the English language is added a preface by F. H. A. Marshall, C. B. E., Sc.D., F.R.S., Fellow and Dean of Christ's College, Cambridge, in which this eminent scholar emphasizes the need for more restraint over man's productive functions as a matter of the future interests of humanity. But the problem we as physicians are immediately concerned with is not so much sociologic as individualistic in character. The poor parents who can give a proper start in life only to a limited number of children have a right to receive proper advice from their physician in matters of birth control, especially under present conditions of economic stress. This information, as was pointed out in the review of the original German edition, is presented by Professor Knaus in a practical yet scientific manner, based on original research. The translation has been well done, which applies also to the booklet containing a menstruation calendar furnished with each copy. Additional copies of this calendar as well as the English edition of the book are distributed by the Concip Company, Hobart, Indiana.

A TEXTBOOK OF ORTHOPEDIC SURGERY FOR NURSES. By *Philip Lewin*, M.D., F.A.C.S., Associate Professor of Orthopedic Surgery, Northwestern University Medical School, Attending Orthopedic Surgeon, Michael Reese and Cook County Hospitals; Professor of Orthopedic Surgery, Cook County Graduate Medical School, etc. Cloth. Pp. 389 with illustrations. Second Edition. Price, \$3.25. Philadelphia: W. B. Saunders Company, 1934.

This volume is the second edition of an excellent textbook of orthopedic surgery for nurses, written by an experienced teacher of orthopedic surgery. It is of value to physicians, nurses and technicians

interested in physical therapy, because many affections where physical therapy is indicated coming under the modern classification of orthopedic surgery, utilize physical methods in the sense of its excellent supportive and adjuvant value.

Every physician treating orthopedic cases should thus make use of this book for his own benefit and for that of his nurse and physical therapy technician. Good results in the treatment of orthopedic patients are dependent on the orthopedic surgeon, who should be able to supervise the physical therapy, and instruct his nurse and the physical therapy technician in their extensive use. The nurse and the physical therapy technician must understand the duties of each other, for nursing care often involves the continuation of physical therapy at the bedside, or in the home. This book has the virtues of concise diction, clear description, and complete orientation with the progress in the field of orthopedic surgery.

OLD AGE MEDICALLY CONSIDERED. A Series of Papers by Medical Authorities on the Physical and Dietetic Treatment of Diseases and Disabilities of Old Age. With a Foreword by *R. King Brown*, B.A., M.D., D.P.H. Carton. Price, 3 shillings. Pp. 96. London: The Actinic Press, Ltd., 1934.

This small volume is a collection of 12 articles reprinted from the *British Journal of Physical Medicine*. The principal subjects treated are: Diet, Ocular Diseases, Neuritis, Sciatica and Lumbago, Cardiovascular Disease, Deafness, Kidney Disease, Skin Affections, Physical Treatment of Cardiovascular Disease, Respiratory Disorders, Exercise and Recreation. While no attempt has been made to discuss the diseases exhaustively, the various authors have presented a critical survey which is adequate for the purpose of the book. Many hints are given for the diagnosis and evaluation of a number of affections commonly seen in senescence. While physical methods of treatment have been stressed, as is proper, the authors have not omitted to point out their limitations and even contraindications, nor have they failed to point out the cases in which medicinal or surgical therapy should be used exclusively or in combination with physical agencies. Thus in the chapter on eye affections there is no other way of controlling presbyopia except by lenses, while cataract and glaucoma call for surgical intervention. For prostatitis, massage is discussed in a highly satisfactory manner, but in advanced hypertrophies of the gland transurethral electroresection is the method of choice. The psychic element in the management of diseases of old age is lucidly discussed. While the book was prepared primarily for physicians, its diction is so simple that it may occasionally be placed in the hands of intelligent laypatients, as its perusal may assist in securing their cooperation.

INTERNATIONAL ABSTRACTS

Further Experiences with Ultrashort Wave Therapy in Gynecology. Franz Wittenbeck. (Weitere Erfahrungen mit der Ultrakurzwellentherapie in der Gynäkologie.)

Strahlentherap. 50:348 (June) 1934.

The author was working with the high efficiency short wave apparatus "Pyrotherm" of the Siemens-Reiniger factory. That apparatus is practicable and highly efficient for local penetration of heat, on account of a condenser circuit of 1000 watts. Radiation was at first given daily, later every other day for 10-30 minutes. The results were remarkable both subjectively and objectively. Favorable results were seen in acute and subacute inflammations. One patient had an acute inflammation and a large solitary tumor which entirely filled the pelvis. Short wave therapy was successful, both constitutionally and locally. That method of treatment appears to be most auspicious when suitable apparatus is used, and seems to be superior to diathermy.

The author was not in a position to settle the question of wavelength, that is whether the 12 m. wave is best suited for gynecologic inflammatory processes or another wavelength might produce still better results.

The Influence of Wavelength on the Distribution of Heat in the Body with Use of Short Wave Therapy. A. Gebbert. (Der Einfluss der Wellenlänge auf die Wärmeverteilung im Körper bei Ultrakurzwellentherapie.)

Klin. Wchnschr. 13:1563 (Nov.) 1934.

The author concludes that in order to obtain a sufficient deep effect electrodes should be applied at a comparatively large distance. Naturally a most efficient apparatus must be utilized for that reason. Air is the best medium between the electrodes and the body. For practical reasons where compression is indicated, a good quality of glass or a sufficient layer of a porous felt pad may serve for insulation. The size of the intermediate layer depends on the size of the electrodes.

Before starting treatment of internal organs the relative heating effect of which is as yet little known, layers are useful to establish heating effect in the tissues of the adjoining anterior and posterior strata. Real determinations for heating may be worked out on the cadaver or upon anatomical models approaching as far as possible natural conditions in order to be drawn therefrom to arrive at conclusions for the proper way of treating living organisms. A large amount of experimental work is needed to determine the methods of attaining the best possible effects from short wave therapy.

Clinical Experience with Short Wave Therapy. E. Hayer. (Klinische Erfahrungen mit der Kurzwellentherapie.)

München. med. Wchnschr. 81:1467 (Sept.) 1934.

Schliephake and Liebesny have obtained results in short wave treatment which do not admit of an explanation as a pure caloric effect, and therefore ascribed them to a specific biologic process of short waves. We have not as yet come to a clear understanding regarding the character of this effect. By this new way of applying electric power a theoretic possibility is afforded for an homogenous penetration of the part to be treated. The author refers to Kowarschik's experiments where the homogenous penetration with power is attended by success only when a space is left between the surface of the skin and the electrodes. In the treatment the intensity was raised to the highest bearable degree of heat. That rate of intensity always sets in within a few minutes, after which the heating often becomes so strong that the energetic force has to be reduced. No secondary phenomena were noticed. Occasional pains in the bones were present in the treatment of the joints only when the energy was too high.

In neuralgia pains disappeared rapidly. Sciatica was refractory in many cases. Excellent results were had in furunculosis, especially of the lips and nose, though only when it was located at the surface. In acute and subacute gonorrheal inflammations of the joints, relief of pain was observed within a short time. Small effusions were resorbed. In chronic affections of the joints short wave treatment was a failure. In pleurisy acceleration of resorption of the small exudate was brought about. No success was had with empyema.

In affections due to chilling the results observed were most satisfactory. (Cold in the head, bronchitis, catarrh in accessory cavities of the nose.) In endarteritis obliterans and gangrene not the slightest success was obtained.

Short Wave Therapy in Surgery. Martin Haas and Alfons Lob. (Die Kurzwellendiathermie und ihre Anwendung in der Chirurgie.)

Deutsche Ztschr. f. Chir. 243:318 (July) 1934.

Short waves may retain large parts of the heating effect from the surface of the tissue by arranging the electrodes in a manner to concentrate the maximum electric power in the depths of any desired part of the body. A point to be emphasized is that the development of the current lines in the depth of the body does not reveal such great distinction between the diathermy frequencies and the short wave frequencies as many describe. The first and single effect ap-

pearing from treatment in the high frequency electric condenser field is the development of heat in the tissue considered to be of a specific character. The authors believe one should not adapt a separate definition for ultrashort wave and short wave treatment according to the length of waves (3-10 m. or 10-30 m.). They marked the entire sphere by the name "short wave region." It is due to a mistake that the hypothesis was established of a biologic separation for short waves of less than 15 m. As for the rest the authors could verify in a restricted sense only the so-called favorable results of short wave treatment with pyogenic affections. Short wave treatment is by no means qualified to replace surgical therapy in that type of affections. In particular the furuncles of lips and cheeks are to be mentioned. In such cases the short wave treatment should be controlled by a surgeon, as otherwise it might lead to great danger (thrombus in the vena angularis). Unless surgical intervention should become necessary, the authors prefer x-ray treatment, which gives a better result and less tissue reaction. They do not see any progress in short wave therapy for carbuncles, comparable with surgical procedures. They have all the more reason not to do so as the electric operation Seemen has suggested, offers a procedure effecting the discharge of pus and destruction of tissue in a faster, safer and more careful way. Tendovaginitis represents a strict contraindication to the short wave treatment. Generally speaking the indication for short wave treatment in diverse pyogenic infections is considered chiefly with incipient infection or after surgical intervention. Injuries of the joints, lumbago, neuritis, neuralgia do offer a very lucrative field for short wave treatment. No interruption of the patient's daily work, or at least a very short one when treating sciatica means an advantage one has to take into account. No influence at all results from short wave treatment of malignant tumors. People should be warned against a groundless optimism.

So-Called Specific Effects of Short Waves in Malignant Tumors. Martin Haas and Alfons Lob. (Die sogenannten spezifischen Effekte der Kurzwellen bei der Behandlung bösartiger Geschwülste.)

Strahlentherap. 50:345 (June) 1934.

The destructive effect upon tumors by ultrashort waves has repeatedly been explained as a specific biologic effect. The authors' investigations with Jenssen sarcoma and in carcinoma of mice, however, prove that an influence on the tumor and its surroundings by specific effects is out of the question. Results take place only if there is an intensity of the field to an extent to destroy every bit of the tissue including that of the tumors by coagulation.

According to the authors no specific biologic effects are in question as active therapeutic agents, nor would a tolerable amount of heat suffice, as it would only produce hyperemia in the tumor or in the surrounding tissue. Short

wave treatment of malignant tumors would therefore terminate in a rise of heat in the tumor and to burning. Such a method means a step back as compared with the older, trustworthy methods of x-ray irradiation, surgical, and electrosurgical treatment. The authors gave no results from their attempts to influence malignant human tumors by short waves.

(This condemnation is apparently prejudiced and premature. The time is not yet for a final decision, considering that radiathermy properly employed has been shown to possess a decided influence on experimental malignant neoplasms.—Editor.)

Cancer of the Breast. R. J. Wilkinson.

West Virginia M. J. 30:348 (Aug.) 1934.

In giving a brief resumé of the history of treatment of this condition the author mentions Handley as pointing out the importance of the lymph channels as routes for metastasis. This knowledge has helped surgeons to conform their operations to removing these channels. "Also this observation has been of tremendous help to the radiologist, for by directing the x-ray or radium treatment to these particular regions, much better results are being obtained."

"Fitzwilliams of London concluded after treating 250 cases with radium that surgery is unnecessary since equally as good results can be obtained by this treatment."

"Pfahler and Perry are most optimistic relative to the pre-operative and post-operative treatment. They contend that by irradiation, 46 per cent with gland involvement survive the five year period and that 38 per cent of inoperable cases were made operable with 10 per cent living beyond five years."

"In summarizing the literature one can conclude that a great majority of our leading clinics, here and abroad, agree that early operation offers the best results and that in the more malignant growths radium and x-ray treatment exert a tremendous influence on prolonging life and in some instances may actually be curative. This statement is borne out by Truot and Peterson of Roanoke, who mailed questionnaires to 199 radiologists and 148 surgeons relative to the value of irradiation in breast carcinoma. Ninety-one per cent of the radiologists and eighty-nine per cent of the surgeons replied in the affirmative."

The author's summary follows:

1. Surgeons and radiologists are agreed that early operation plus radiation offers the best results.
2. After glandular involvement the incidence of a 10-year cure is reduced approximately 75 per cent regardless of the treatment.
3. No physician can diagnose breast tumors accurately without microscopical tissue examination.
4. It is the duty of every physician to become interested in the cancer prevention campaign; certainly to the extent of recognizing early precancerous lesions and advising proper treatment.

What Have We Been Knowing Up to the Present of inflammatory Genital Hemorrhage and its Treatment? Erich Hoevelmann. (Was wissen wir bis heute von entzündlichen Genitalblutungen und ihrer Behandlung?)

Ztschr. f. Geburt. u. Gyn. 107:203 (Feb.) 1934.

Several authors have tried to stop uterine hemorrhage by using the effective substance of the mammary glands—the mammin. Up to the present, success of this therapy offered but little satisfaction. Attempts were then made by provoking hyperemia and consequently to promote the production of automammin in the mammary glands of women suffering from uterine hemorrhage. Three methods are considered: 1. Production of hyperemia of the mammary glands by application of heat (electric heating pads or similar methods); 2. Production of passive hyperemia as practiced by Bier's glass suction bell; 3. Production of hyperemia in the mammary glands by a galvanic current combined with some fixed additional medication. A large plate is placed over the mammary gland serving as cathode and this wadded by a pad of 0.1 per cent potassium iodate solution. The anode is applied to the vagina and consists of a carbon electrode wrapped into a wadding of a 0.1 per cent calcium chlorate solution. A speculum will unfold the vagina. Treatment time is 20-40 minutes and is to be repeated daily or every other day. Following each treatment there is evidenced painful symptoms resembling labor pains and bleeding, but this ceases entirely in a short while.

Indications for the procedure as described above are:

So-called functional hemorrhages, reduced contractibility of the uterus in hypoplasia, cirrhosis, fibromatous degeneration, chronic inflammations in the small pelvis (unless a rise of temperature would occur) and cases of subinvolution of the uterus, post abortum or post partum. The procedure is contraindicated for the poorly developed pathologically transformed mammary glands.

Another author (Kuestner) suggested red light for treating of intensive genital bleeding. The abdomen and the frontal part of the upper thigh were irradiated within a distance of 50 cm. for one-half hour on the first day, later on for one hour daily. Cases of moderate hypoplasia reacted most favorably.

When hemorrhage would be based on inflammatory diseases of the adnexia, x-ray treatment irrespective of all theoretical confusion, has brought about such clinical success, that we believe this method to be the selective one for conformable cases. Even inflammatory processes of longer duration, not revealing any healing tendency, have improved after irradiation.

Radium Emanation and the Organism. (Radium-emanation nud Organismus.) J. Markl.

Strahlentherap. 49:92 1934.

The literature is reviewed. Exact measurements are given of the radioactivity of the bath and air above the water and the blood at different

periods during and after the bath are made. The average ratio of the maximal concentration of radium emanation in the blood to the concentration in water was found as 1.7 to 100. A quantitative comparison of the energy produced by the alpha rays with the biological threshold value established by Zwaardemaker leads to the conclusion, that radioactive baths of about 100 Mache units per liter reach the threshold of biological activity; and the mechanism of the radioactive bath does not consist of inhalation of radon contained in the air above the water, but of the resorption of the emanation through the skin, the impact of the corpuscular rays upon the skin and the penetrating effect of the gamma rays emitted from the whole volume of radioactive water.

Modern Finsen Therapy. (Die moderne Finsenbehandlung.) S. Lomholt.

Strahlentherap. 49:1 1934.

This paper, written by the director of the Skin Department of the Finsen Institute in Copenhagen, describes first the various biological effects of ultraviolet. General ultraviolet treatment using sunlight and carbon arc is discussed with particular attention to the treatment of such conditions of the circulatory system, pulmonary and extrapulmonary tuberculosis, skin diseases, such as lichen ruben, psoriasis, prurigo, acne vulgaris, erythema pernio, purpura. Local ultraviolet therapy is applied by use of concentrated sunlight and carbon arc. The new Finsen-Lomholt lamp and its use is described, for the treatment of lupus vulgaris, lupus erythematosus, erythema induratum, Boeck's sarcoid, neurodermidis chronica, eczemas, naevi, rhinophyma and x-ray lesions.

On Radium Treatment of Induratio Penis Plastica. Anton Musger. (Zur Radiumbehandlung der Induratio penis plastica.)

Wien. klin. Wchnschr. 47:1352 (Nov.) 1934.

The affection manifests itself by solid indurations of the penis, lamelliform for the most part and located dorsally, rarely located also in the corpus cavernosum of the penis. Pains occurred during erections and during coitus through bending of the erigated penis, resulting in functional impediment. Beneficial results of treatment with radium were obtained by Kumer, 1922, Riehl Sen., 1924, Fuhs, 1929.

Hardly any other than Dominici-tubes were used. On account of deep seated pathologic changes the supports were filtered through a one mm. brass filter. In order to shunt off the secondary rays the supports and the filter were wrapped in gauze or gutta-percha and fastened right to the penis by means of adhesive plaster. The initial dosage was an average of 40-30 milligram element hours. In subsequent exposures it was lowered to 20-15 milligram hours. Intervals were between exposures of two, later of four weeks duration.

Among 120 cases which were treated by radium, 27 were recorded as clinically recovered.

30 as improved, 24 cases were refractory, 39 patients did not return after first irradiation.

X-ray examination of the seat of the disease is most important, as no success can be expected in cases with bony foci or rich in calcium. In other cases 10-14 exposures are required for a pronounced success.

Alleviation of the Reaction Upon Small-pox Vaccination by Therapeutic Means. E. Barla-Szabó. (*Milderung der Pockenimpfreaktion auf therapeutischem Wege.*)

Arch. f. Kinderh. 101:1 (May) 1934.

To prevent lesions of vaccination occurring after children are immunized by cutaneous vaccination against small pox, x-ray irradiation of the reacting part may be given in the form of areal formation. Dosage: two H with a three mm. Al-filter. Only one exposure is required, except in the case of very intense reaction and great infiltration where the irradiation was repeated after two days. In defiance of such therapeutic measurement complete immunization took place. Regression of the reactive process and of general symptoms promptly ensued. The procedure is suggested in reactions of abnormal intensity, in sensitive children, and in healthy children with whom some unexpected intracurrent diseases may appear while reaction is developing.

Dosage in Ultrashort Wave Therapy. The Influence of Intensity of the Electric Field and of Frequency on Staphylococci and Streptococci In Vitro. E. Hasché and W. Leunig. (*Zur Dosierungsfrage in der Ulteakurzwellentherapie. Einfluss von Feldstärke und Frequenz auf Staphylokokken und Streptokokken in vitro.*) Strahlentherap. 50:351 (June) 1934.

By the method of using ultrashort waves of 8-16 m. there is no proof of direct effect by the electric field or the frequency, none for effects of selective heating on staphylococci in distilled water, in a physiologic NaCl-solution or in bouillon, nor on streptococci in milk. Despite all, the authors emphasize that the negative finding does not affect the great success of this therapy in purulent infectious processes.

Influence of Ultrashort Waves on Malignant Tumors. E. Hasché and W. A. Collier. (*Ueber die Beeinflussung bösartiger Geschwülste durch Ulteakurzwellen.*)

Strahlentherap. 51:309 (June) 1934.

The authors chose the stock of Ehrlich's carcinoma of mice presenting the picture of peritonitis carcinomatosa, which in intraperitoneal inoculation evidenced extraordinary virulence; while in subcutaneous inoculation growth was rather slow. From a mouse just killed they took some material for either direct irradiation *in vitro* or for inoculation of other mice for subsequent irradiation. Their experiments were negative with 3.5 m. ultrashort waves.

Radiosensitivity — Its Value as a Therapeutic and Prognostic Index. Eugene V. Powell.

Texas State J. Med. 30:405 (Oct.) 1934.

The author explains that by radiosensitivity is meant the relative order in which the various cellular components of the body are destroyed or lose their ability to reproduce themselves, after exposure to roentgen or radium radiation of known quantity and quality. Radiosensitivity is influenced by many factors, most of which are known and have been evaluated. These are reviewed and their clinical value discussed.

By 1915, experience has taught us that neoplasms generally were radiosensitive in the following order:

1. Lymphoma.
2. Embryonal tumors.
3. Cellular anaplastic tumors.
4. Basal cell carcinoma.
5. Adenocarcinoma and adenoma.
6. Demoplastic tumors as squamous carcinoma and fibrocarcinoma.
7. Fibroblastic sarcoma, osteosarcoma and neurosarcoma.

Reference is made also to Broder's work and to Ewing's researches, and Ewing's tale of determination of radiosensitivity is reproduced. This classification is analyzed and the authors opinions injected.

A Study of Comparative Effects of Various High Frequency Currents and of Thermal Cauterization in Prostatic Resection. John R. Caulk, and Wilbur Harris.

J. Urol. 32:449 (Nov.) 1934.

In using the various high frequency cutting instruments, tissue damage is often produced more deeply than is generally desirable, and often to some extent is unavoidable. High current densities applied for more than a second may do damage at depths from a few millimeters to over a centimeter.

In order that tissue may be cut in with high frequency currents, an intense heat is required at the active electrode. To produce this heat it is necessary for the current to pass through the tissue from an indifferent electrode and focalize at this point. In so doing, the paths of the current, in their concentration toward the active electrode, generate varying degrees of temperature deep within the tissue, away from the point of active burning; whereas in removal with the actual cautery, approximately the same temperature is applied at the surface of the cut, but no heat is produced within the tissue, except by conduction from the surface.

Analysis of experiments with high frequency currents shows conclusively that, at depths within the tissue of at least 1 cm. away from the active point of burning, temperature changes well beyond the thermal death point of tissue have been produced; whereas with the actual cautery, the heat registrations less than 0.5 cm. away, after repeated applications at the same site, have been negligible. The temperature which causes thermal death to tissue cells certainly lies

between 44 and 52 degrees C., probably about 47 degrees C. The heart stops beating in cats, dogs and mice at a temperature of from 44 to 45 degrees C. Chick cell cultures cease to grow and finally die after a few days of exposure to 44 degrees C.; at 47 degrees C. they die in 1½ hours; and die immediately on reaching temperatures around 50 degrees C.

An analysis of the specimens removed with high frequency excisions shows varying grades of tissue destruction in these distant areas, and according to physical principles will demonstrate more pathologic insult than the tissue removed by the active electrode, for the simple reason that the current penetration in the underlying tissues is greater than that in the tissue removed. In the cautery removal the opposite is true.

In prostatic resection it is essential to shift the scene of activity from one portion of the gland to another in order to deviate the paths of current, to avoid accumulative heating, and not to concentrate on any one segment except for a short period. It is highly important that the minimum cutting current be employed for a minimum of time. If bleeding should occur it should be controlled with coagulating currents, which are far less penetrating and damaging. Often the cystoscopist is misled in interpreting the coagulation picture as giving evidence of a severe reaction when in reality the damage is much more superficial than the clean appearing surface resulting from the cutting current. If simple coagulation (not mass coagulation) is effected at one-third the current value employed for cutting, only one-ninth the heat will be produced. It is signally important to allow a proper cooling time between cutting strokes.

The larger the field of operation, the greater the chance of complications and the burden of healing. The healing processes at the bladder neck under these conditions are somewhat hampered by bladder motion, which has a tendency, through its contractions, to disseminate infection and to unplug vessels. It seems evident that late secondary hemorrhages, a complication more commonly found following high frequency electric resections than with other methods, has its explanation in the discharge of the first two zones of necrosis.

Another important feature to be remembered, in the conduct of high frequency operations, is the possible influence of penetrating heat upon the vessel sphincter. It seems highly possible that incontinence following these operations may be the result of devitalization of the sphincter through excessive heat. Urinary extravasation may result from the same process, provided the burning is carried too close to the surface of the gland.

Removal of prostatic obstruction by cautery or by methods which involve very mild coagulation followed by excision of tissue or by cold cutting procedures followed by coagulation possess less inherent dangers than methods which employ any type of high frequency cutting.

The Treatment of Diseases of the Cervix by the Electrosurgical Unit. M. Lyon Stadiem.

Am. J. Obstet. & Gynec. 28:514 (Oct.) 1934.

The electrosurgical unit as advocated by Hyams in 1928 and later by Roblee in 1931 was used. The diseased area of the cervical canal was eliminated, just as in the Sturmdorf operation, without impairment of the integrity of adjacent tissues. Cervical stenosis and other anatomic distortions did not follow its use. The immediate effects were so slight that the patients remained ambulatory and resumed their usual occupations with practically no delay.

The apparatus is supplied in two types, the radio-tube, and the spark gap. Electrodes are of various shapes and sizes. The technic is almost precisely the technic originally described by Hyams, but in cases of eversion complicating chronic infection use was made of triangular rather than the spindle-shaped electrode, in order to eliminate recutting.

This method was used in 202 cases of cervical infection, including: 107 cases of chronic cervicitis and endocervicitis; 50 cases of cystic cervicitis; 45 cases of cervicitis complicated by simple, follicular or papillary erosion.

All of these patients were treated in the clinic, under local analgesia. The cervix was coned out with the conization electrode (cutting current) and all of the diseased, gland-bearing area of the canal was removed, just as in the Sturmdorf operation. Cysts were punctured with the straight electrode.

The Treatment of Prostatic Hypertrophy by a New "Shrinkage" Method. Thomas J. Kirwin.

J. Urol. 32:481 (Nov.) 1934.

Non-destructive shrinkage is a heat treatment by high frequency current, a given current density being applied to a measured area of tissue for a definite length of time. The unit of measurement of current density is called a millimil. The depth to which the heat will penetrate during a given time period can be predetermined.

Such thermal shrinkage should not be confused with electrocoagulation, nor with fulguration, as these methods are destructive. The shrinkage method, as its name implies, withdraws fluid and coagulates albumen, so that the treated tissues are reduced in volume and changed in consistency. The temperature within the tissues is raised to a degree which kills living adenomatous cells, but does not injure blood and lymph vessels. The object is to carry the heat treatment beyond the point of tolerance in the unanesthetized patient (in diathermy), but not to the point of destruction of tissue as in coagulation.

This method is "new" only in the better control of the amount of heat applied. By coagulation of albumen and evaporation of tissue fluids, the gland will be greatly reduced, without subjecting the most debilitated patient to the chance of surgical shock.